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OF THE
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ASSOCIATION
(ENGLISH EDITION)

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INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION VIII.

Application of rational organisation (planning) to the transport of goods,

especially in connection with:

1. **the functions and internal working of shunting yards;**
2. **the provision of inter-yard connections;**
3. **the estimation of the probable traffic to be dealt with, and the provision of the trains required;**
4. **the information to be given to consignees;**
5. **the acceleration of the turn-round of empty stock;**
6. **the use of containers and rail-road wagons.**

REPORT

(Great Britain, Dominions & Colonies, North & South America, China & Japan.)

by V. M. BARRINGTON-WARD, D. S. O.,

Superintendent, Western Section (Southern Area), London and North Eastern Railway.

The questionnaire was sent to 63 Railway Administrations: 28 replies have been received, of which 7 gave no information. The remaining 21 have provided little information which would lend itself to a comparative study. This is partly due to the somewhat vague and general nature of the subject, which covers on very broad lines particular points which have been discussed exhaustively at recent Congresses. Generally speaking, train working, yard working, advice to consignees and the operation of empty stock is on similar lines throughout the zone of enquiry. The only really new material which appears to be at all instructive is the use of containers — a development which has taken place extensively since the last Congress.

1. — Operating of shunting yards.

At all shunting yards the work of splitting up trains is carried out in accordance with a definite scheme, but such schemes vary considerably with the operating conditions at different yards. It is not practicable to state any standard procedure which would be applicable to all yards. There are numerous shunting yards — large and small, originally designed according to different traffic characteristics. In a number of instances additions and improvements at shunting yards have since been made to enable traffic to be dealt with more satisfactorily, but many yards could not be remodelled owing to physical limitations and also owing to the interruption or even cessation of operating work during conversion, which could not be faced.

During recent years the tendency to concentrate large numbers of wagons at one marshalling point and construct new yards on a large scale has increased. But the large marshalling yard is not always the most desirable : for instance, yards on the scale of those in use in America or on the Continent are not generally suitable to British conditions and can only be justified in a few exceptional cases. The alternative, for which British conditions generally seem to call, is a system of sectionising at the loading point or in comparatively small yards close at hand, and the planning of train services on the basis that sections are exchanged at appropriate junctions. The two mecanised hump yards at Whitemoor (L. N. E. R.) are, however, notable exceptions. They are appropriately situated at an important junction with lines radiating in all directions. By replacing several separate yards of old construction and very limited accommodation, they have secured considerable operating economy and at the same time remedied serious congestion and train delays.

Marshalling yards may be divided into four types — flat, gravitational, hump, mechanised hump (i. e. fitted with mechanical rail-brakes or retarders). The modern tendency is to replace flat shunting yards, wherever possible, by either hump or gravitational yards. The latter type of yard enables shunting to be effected without use of engine power by dropping the wagons from reception sidings into the sorting sidings by gravity. It is estimated that the cost of yard operation is thereby reduced by 20 % or 30 % at least, though the speed of shunting is less than in a hump yard.

At flat shunting yards the wagons or cuts are uncoupled and the appropriate points set on each consecutive shunt. The particular sorting siding is indicated to the pointsmen or brakesmen either by a whistle code or manual signs.

At some hump and gravitational yards, cut cards are prepared on which are shown the numbers of the sorting sidings into which the wagons are to be run and the number of wagons in each cut, together with other details such as train arrival time, reception road number, time shunting commenced and finished. In others, the sorting siding is indicated by chalk on the leading wagon of the first shunt and on the rear wagon of following shunts.

At the recently opened gravitation yard at Mottram, L. N. E. R. the shunter, after reading the labels, and detaching accordingly, passes the information in regard to destination of the cut into a series of microphones fixed behind him and covering his range of work. This information passes direct by loud speaker to the pointsman operating the electro-pneumatic frames in the tower, and he sets the siding points accordingly at once. The arrangement has been found to be simple, precise, and accurate.

Examination of wagons for mechanical defects is usually carried out immediately after the arrival of trains in the reception roads, though in some yards both before and after sorting. By the time the train has been examined, the cut card should have been prepared or the wagons marked, usually by a shunter, and the wagons or cuts uncoupled by the same shunter or, in some cases, by a second shunter. The cut card is passed to the man in the point cabin or control tower, sometimes by means of a pneumatic tube.

In hump yards, the normal practice is to use one humping engine. When, however, the reception sidings become congested, two engines may be employed, one pushing over the hump as the other runs round. The speed of pushing over the hump is normally at an even slow walking pace, though the push-off speed at the start may be considerably greater. In clear weather the speed may be controlled by colour-light or hand signalling, while in foggy weather it will be governed by sound signals conveyed by horn or whistle.

The proportion of locomotive time spent on effective work or actual shunting varies in different yards. Answers to the questionnaire have failed to give any helpful information on this matter : but it may be said that in ordinary hump yards no more — often considerably less — than 50 % of the total engine time is spent in actually propelling loads over the hump. It may be interesting to compare average figures for two large concentration yards on the L. N. E. R. (Great Britain) — Wath, an ordinary hump yard, and Whitemoor, a mechanised hump yard, each dealing with about 5 000 wagons per day — the former exclusively with loaded and empty coal wagons, while at Whitemoor this class of traffic comprises approximately 70 % of the wagon turnover.

Percentage of time spent.	Wath.	Whitemoor.
On effective work	49 %	64 %
On non-effective work	46 %	31 %
Meals and engine requirements	5 %	5 %

The time spent on non-effective work, though not waste in the ordinary sense of the word, is non-effective so far as the business of getting on with the sorting of wagons is concerned. It is due to miscellaneous causes, such as pushing down roads, rectifying wrong shunts, waiting traffic, providing under-runner wagons, guards vans, and so on.

The use of rail-brakes or retarders and automatic point operation from the control tower is primarily responsible for the better percentage figures at Whitemoor.

The question of braking in marshalling yards was examined in detail at the Madrid Congress in 1930, and it is not proposed to discuss it at length in this report. It may, however, be noted briefly that the development of rail brakes in Great Britain and car retarders in America has been very different, for in the former, following the German principle, two or four brakes only are placed at the base of the hump, whilst in the latter as many as sixty may be scattered all over the sorting sidings, as well as at the base of the hump. It will be appreciated that the former is far cheaper to operate provided the braking is equally efficient.

In mechanised hump yards less brakesmen need be employed, since they are stationed not at the crown of the hump to follow cuts down, as in an ordinary hump yard, but beyond the retarders. Each brakesman is responsible for a group of sidings, approximately 10 in a mechanised yard, and half or less than half that number in an ordinary hump yard. In the control towers of mechanised yards further staff is, however, required to operate the retarder mechanism, according to the rate of shunting and the number of retarders in use, In the first hump yard at Whitemoor there are four Frölich hydraulic rail brakes at the foot of the hump, each of which controls wagons running into a group of 10 sidings. In the second yard there are two Westinghouse eddy current electro-magnetic brakes at the foot of the hump, which control a similar number of sidings (viz. 40, in two groups of 20) but deal chiefly with empties. In the former yard the apparatus is controlled by two operators, in the latter by one only from the control towers. Another operator is stationed at the switchboard in each tower and, on receipt of the cut card, is able, by manipulating certain levers, to store up electrically in a drum the route movement for the first seven sets of points. The wagons, in passing down the hump and through the retarders, or rail brakes, automatically set the points for succeeding wagons, in accordance with the routes previously stored in the switch drums.

In yards where the points are manually operated and more than one pointsman is used, each pointsman takes care of a certain district of the yard. In some instances the points are hand-operated by individual tumblers or levers and in others from ground frames, or from elevated cabins with levers in groups. In yards where braking is not effected by means of rail brakes all braking is carried out by means of the hand brakes on wagons, supplemented in one or two exceptional instances by slipper or shoe-brakes. On the Madras and Southern Mahratta Railway, though hand skids are in general use, it is the practice to do without them as much as possible, because the axle guards and stays get jarred and are frequently damaged.

The work is supervised usually by a foreman stationed at the summit of the hump or at the shunting neck. The foreman's cabin is usually placed here and should be in telephonic communication with all parts of the yard, so that from his position he can exercise a general direction over the whole of the movements. The foreman in turn will be responsible to an inspector or assistant yard master, who is himself directly responsible to the yard master for the operation of the whole yard.

Detailed sectionisation for specified destinations is performed when necessary, usually at the departure end of the yard. The allocation list of a big yard should be such that both the staff at the hump or shunting neck should know into which sorting sidings each wagon has to be diverted and the shunters at the departure end should know what destinations they will find in each road.

The wagon or truck position in a yard is closely watched and a census is taken at varying intervals (every 3 hours in some yards, 6 in others, and so on, according to requirements). Particulars of wagons on different roads may be furnished by shunters either verbally or on the telephone, or, in some yards, by inspectors and yard foremen in the course of their ordinary duties.

2. — Train service between marshalling yards.

Freight traffic is worked between marshalling yards by all classes of freight trains — fully-braked, partially braked, loose coupled, etc. In the case of adjacent yards, trip working is the established means for the interchange of traffic. The number of trains and trips will vary according to the capacity of the yard and the class of train according to the nature of the traffic dealt with. In the regular traffic between yards, trains and trips are usually worked according to a fixed timetable based on line occupation and the incidence of traffic.

Trainloads vary considerably according to the class of engine used and the controlling gradients en route : they are made up on either an axle or a weight basis. Maximum speeds are laid down for certain classes of freight trains and point to point timings are worked out for all classes of freight trains.

Wagons not despatched by scheduled trains are grouped as rapidly as possible and sent away by special trains, which are arranged through the control offices as required. Where no control system is in operation, information has to be communicated by telephone, telegraph or special message through stations or signal cabins. Throughout this report it should be understood that, in the absence of the control system, such is the procedure. It may be noted, however, that the majority of railway administrations who have replied to the questionnaire are equipped with this modern phase of railway operation. In many instances spare « paths » or conditional trains (to run when required) are provided in the working timetables. Special trains when arranged are, if possible, given specific timings by a timing office situated at headquarters or in a district office according to the organisation, and these are advised to the line (signal-boxes, yards, stations, etc.) in advance. When time does not permit a detailed timing, the district control will make the necessary arrangements in consultation with other district controls and the headquarters control.

The decision to run special or extra (as required) trains rests usually with the district controller or district superintendent, who works in conjunction with yard officials and relies on the information supplied by the various yards as to the volume and nature of the traffic awaiting clearance. The time which elapses between such a decision and the actual departure of the train varies considerably according to circumstances and will depend on such factors as availability of engine and train crews, line occupation, etc. The request may be urgent and an engine may be made available in thirty minutes. Normally, however, some hours' notice is given. Short notice specials may be worked by engines already manned and prepared or engines employed on local services which have not completed a day's work.

The running of special trains is not strictly governed by stipulations as to minimum loads or minimum number of axles. Every effort is made to maintain full loading, but lower loading is dependent on various factors, the most important of which are : urgency of traffic to be cleared, the prospect of clearance by scheduled trains within a reasonable time, demand for empties at the destination point, urgency of traffic awaiting clearance en route. Similarly the use of unbalanced locomotives is encouraged, provided that the load is a reasonable one.

The relief of engines and train crews is part of the function of the control organisation, where it exists. District control offices are furnished with complete particulars of the time at which the crews sign on duty and the depots to which they are attached.

The proportion of special and extra (as required) trains to the number of regular trains varies to such a degree that it is difficult to give any reliable information, and it is considered that average percentages would be of little or no value.

The running of these trains is, however, closely supervised by the district control offices and is revealed in statistics prepared either by the yard or the district office. Special mileage is regularised wherever possible; generally this depends on the character of the traffic and its degree of frequency throughout the period of the seasonal working timetable. The period of review varies considerably, but six months may be regarded as a general average.

3. — Additional traffic and how provided for.

The source of information as to additional traffic varies according to the railway organisation. Generally speaking, the commercial manager's department is responsible for advising the operating department, or, alternatively, the commercial office, or a combined operating and commercial officer, will advise the operating or control office. In some cases, however, control offices are not only advised through the commercial department but acquaint themselves of anticipated changes in traffic flows by contact with the originating points such as collieries (e. g. L. M. S. R. and L. N. E. R. — Great Britain).

The operating offices act as a medium for alterations in traffic. The control system (a central control co-ordinating the work of district controls) often acts in this capacity, or the superintendent and his district officers may have separate train offices which act as a liaison between the control offices and the commercial department. It is important that such information should pass through as few hands as possible before reaching the actual operating office.

Where the control system is in operation, marshalling yards receive advance information of the composition of trains from the district control offices, who are in direct telephonic communication with such yards. Where there is no control system, telephonic or telegraphic advice is sent to the marshalling yard from the various depots. Regular trains are usually marshalled in a definite order at the originating points. In some cases the grouping of wagons on extra trains is advised to the marshalling yard, but this is not always considered to be necessary No answer to the questionnaire has revealed actual details and results of such arrangements, but present practice in every case is considered to be satisfactory.

The supply of empty wagons to cop with sudden rushes of traffic is effecte through the wagon control system or it equivalent organisation. The local Agen is aware when these conditions arise an communicates with the wagon contro by means of the daily requisition forn and, in urgent cases, by wire, to suppl the necessary wagons. Special prov sions are made for seasonal traffics.

When the wagons are loaded it is cu tomary for the consignors to advise tl Station Master or local Agent, who con municates with the district contr office, which should make all necessar arrangements when traffic cannot lifted on the regular booked freight-tra service.

4. — Advice to consignees.

The arrangements for advising co signees of the arrival of goods are vari and depend on the nature of the traff and the location of the consignee. A four methods — post, special messeng telegraph, telephone — are used accor ing to circumstances. Certain railw companies — notably some of the Indi Railways — do not undertake to se any advice. Where delivery is made a railway company or taken by a trac shortly after arrival, no advice is nec sary : regular traffics or standing ord rarely need advice, and at most Afric and Indian stations the consignees their clearing agents are on the spot.

Consignees of livestock and highly perishable goods are in most cases advised of despatch by senders and are able to gauge approximately when the traffic will arrive. Reference to the receiving station will elicit more accurate information. They can, therefore, generally make their arrangements in advance. When such arrangements fail, consignees are notified by telephone. On the English Railways no perishable traffic is allowed to remain on hand without such steps being taken, and often the railway company delivers without waiting for instructions. On one or two railways livestock is never accepted for transit without an attendant, in which case no advice is necessary.

The time which elapses between the arrival of the wagons and the despatch of the advice varies considerably according to the nature of the traffic and the size of the depot. Advice notes are despatched as soon after the arrival of the traffic as is practicable. In Great Britain and U. S. A., for traffic arriving during the night and early morning, notice is given to consignee between 8.0 a. m. and 9.0 a. m.; for traffic arriving during the day, notice is given as soon as practicable after arrival.

In no known case is the advice sent in advance by the sending station, but the receiving station does not always wait for the charges to be checked. On the Buenos Aires Great Southern and Western Railways, if the consignee's name figures on the wagon or package label, advice is sent on arrival of the wagon without waiting for the documents. On certain traffics, however, it is important that the charges should be checked (e. g. English market traffic) as traders often prefer to prepare their accounts for settlement with senders daily.

The consignor frequently advises the consignee of the despatch of wagons, but this does not enable consignee to fix time of arrival of wagons without consulting the receiving station, unless he knows from experience the usual arrival times. Some traders in certain countries have resorted to an unfortunate practice of assuring their consignees that goods have been despatched by rail before they have been actually consigned. This abuse gives rise to many unreasonable complaints from consignees and the railway company often finds difficulty in acquitting itself of the blame. On the Central Argentine Railway, however, the consignor's advice to consignee is a duplicate copy of the consignment note made out at the despatching station, and the two documents will, therefore, show the same date. Without this document delivery cannot be effected at destination.

In most countries at the present day it is possible to despatch goods according to timetables and by trains which sometimes attain the same speed as ordinary or even express passenger trains. But in all known cases in this zone the freight train timetables are published privately and for use of the company's servants only, who furnish consignors and consignees with more general information indicating the latest time of acceptance and the normal time of delivery at destination. In Great Britain certain publications are issued for the guidance of traders to indicate the departure and the arrival of freight traffic in through wagons between a number of the principal towns. Any information desired in regard to the freight services between places not mentioned in these booklets is furnished by the local agent in reply to inquiries.

Invoices are generally forwarded by passenger train when such means of transit will ensure the invoices or waybills reaching the destination before the goods. There are a few specific instances where this practice is not adopted — the Central Argentine Railway, for instance, does not consider it good policy as the documents may be necessary to check up consignments on occasions of suspected pilferage, shortage or damage. Where the passenger train service will not give an earlier arrival, wagon-side despatch is, of course, the most effective method.

It is usual for the last marshalling yard to advise the destination station of the general composition of its trainloads, but it is not considered practicable to advise detailed particulars of the traffic. In Great Britain and U. S. A. this practice is confined to special traffics (e. g. registered and perishable traffic) and, in some cases, to the more important through trains. Some of the big London goods depots are wired by the forwarding stations of the despatch of meat and fish, and wires are also received from the last marshalling yard of the number of wagons on each train. This information enables the yard working to be planned accordingly and sufficient cartage strength to be supplied so that deliveries to market will be satisfactory.

The goods advice and delivery note is a document advising consignee of the arrival of goods specified therein. As such it would not, in normal circumstances, be issued until receipt of the traffic. Generally speaking, preliminary notification is given to consignee only as a matter of information and is not binding on the company or administration concerned. The disadvantages which arise when wagons are not placed for unloading at the time fixed are of a commercial rather than a strictly legal nature and may lead to a serious loss of traffic. For this reason alone it is inadvisable to give such a preliminary notification without making certain that the wagons can be really placed at the time fixed. On market traffic, more especially perishables, claims are made for loss of market and sometimes for a lost journey, when consignees send for the traffic and it is not available. The question of compensation depends entirely upon the circumstances.

5. — The acceleration of the turn-round of empty stock.

This question was discussed at considerable length at the Cairo Congress and no further suggestions have been forthcoming from this zone, except that the South African Railways and Harbours make a general recommendation « that constant improvements in the control and working methods be instituted to obtain conservation of truckage and expeditious movement of empty wagons ».

On railway systems, where the question remains acute, wagon turn-over is closely watched by a wagon distribution office at headquarters and its district allocating centres; each subsidiary centre allocates wagons within its own district, and the central office co-ordinates and effects inter-district-exchanges. In some cases advance advices of the movement of loaded trucks into areas or districts are rendered so that the released empty vehicles can be readily used in the vicinity.

Long distance movement of empties such as those from ports to inland centres in export countries, and those from inland centres to ports in import countries, are undertaken in block loads at fast goods speed throughout.

On the Central Argentine Railway, during the peak periods of grain movement, available stock barely keeps pace with requirements. When little or no classification is necessary, empty trains are formed at the points of discharge and despatched direct to destination, thereby avoiding concentration yards.

Empty stock is not normally accorded preference over loaded wagons. There are, however, occasions when empties have to be given special transit and these may displace non-urgent loaded traffic, when consignees will not be inconvenienced. For centres where there is a regular demand for empties which cannot be supplied on the spot there is usually an established service of direct trains run at accelerated speeds.

Senders are usually advised by the local Agent or station master whether their orders can be met and when. When there is delay in meeting orders through shortage or service contingencies, senders are notified by telephone or special messenger. The seriousness of competition set up by other means of transport necessitates the exercice of much local tact, assistance and initiative in dealing with traders, and such initiative is liable to be killed, if wagons cannot be readily guaranteed.

Empty wagons are supplied to large works several times during the day. The placing of empties and clearance of loaded trucks is usually effected at the same time. As a rule large works are served at stated times, usually in the evening, during the night or in the early morning, and sometimes about midday, so that no interruption of operation in the works is caused.

Where unloading is supervised by the station staff, the time of release is, of course, known. When the consignee supervises his own unloading, advice of release is only given in some instances, and when the information is requested by the railway company. If railway-owned wagons are not unloaded within a specified period, demurrage is charged. One of the recommendations made at the Cairo Congress was « To apply with the greatest circumspection charges such as for demurrage, and for non-use, deposits, etc., likely to irritate traders and alienate their custom ». While this may be a commercial necessity, it is difficult to see how railway companies, even when equipped with sound wagon control organisations, can be expected to operate efficiently and economically when a premium is granted to the trader who has been or will be accustomed to look upon the railway wagon as his warehouse.

6. — The use of containers and « rail-road » wagons.

Apart from Great Britain and the U. S. A., the use of containers is limited in this zone to Japan and Australia. The Ceylon Government Railway is experimenting with two container wagons. The Buenos Aires Great Southern and Western Railways have found that the conditions ruling in the areas served by them are such that the use of containers would be impracticable : no specific reasons are given for this statement. The Sudan Railways have no containers in service, but the purchase of special fireproof containers for the transport of explosives is under consideration.

In Great Britain there are no wagons for rail-road transport : there are milk tanks, which have wheels for use on the roads and are run on and off the trucks at the beginning and end of the rail journey, but these cannot properly be termed road-rail units. There has, however, been a marked growth in the use of containers. In 1929 the four main line Companies together had only 3 404 containers; by 1935 the number had grown to 11 269, and is still increasing. They are provided for certain specific traffics : covered type for general goods, manufactured paper, furniture, household removals, etc.; open type for machinery, bricks, slates, tiles, etc.; insulated for meat and fruit : ventilated for fresh meat. The number of open brick containers is at present small, and there appears to be considerable room for development in the movement of low grade building material by container, whereby bricks could be loaded at the brickfields and transported by rail, lorry and crane to the actual building site.

Ordinary wagons with low sides or special chassis wagons are used for their conveyance. Container wagons are all fully fitted for use on express braked trains.

The construction of containers, generally speaking, resembles either the covered van body or open truck type, but is suitably strengthened for lifting by crane.

It has been found necessary to equip depots with better facilities for loading and unloading containers. Considerable development is taking place in the provision of mobile petrol-electric cranes up to 6 or 7 tons capacity. These are found to be very advantageous as they obviate selective shunting and special shunting power in placing containers under fixed cranes. It is not without interest that, at the King's Cross goods depot of the L. N. E. R., two mobile cranes are kept busy for 40 hours each day in loading and unloading containers. Elsewhere use is made of overhead cranes, but these are not considered to be such elastic units as the mobile cranes.

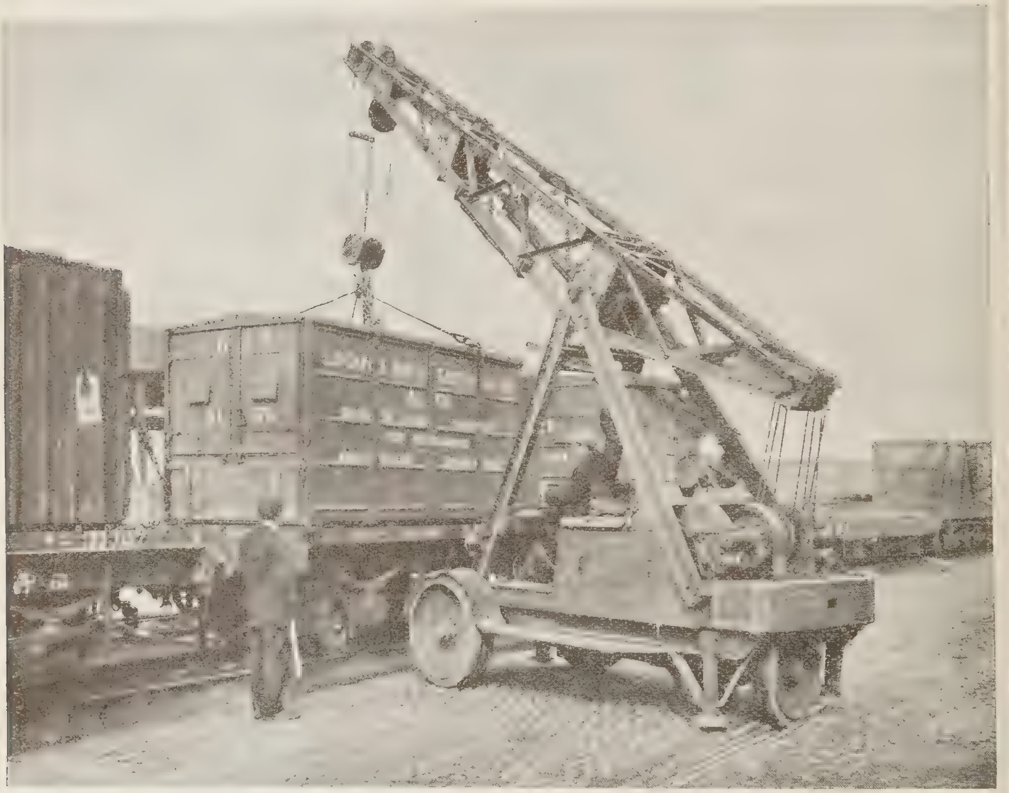


Fig. 1. — British container and mobile crane.

Experiments have been made in container construction, with timber, steel, welded steel, with plywood interior, etc. At present in Great Britain a container committee, representing all Companies, is endeavouring to standardise container equipment. As the use of containers continues to grow, the « common user » of containers and chassis wagons and the standardisation of types will become essential, if the equipment is to be kept to a minimum, the working costs down to an economic level and the stock dealt with in an orderly manner.

The carrying capacity of present containers varies from 2 to 4 tons.

The four main line English Companies have different methods of controlling the distribution of containers. The Great Western Railway and London Midland & Scottish Railway assign this responsibility to a commercial officer, the goods manager; on the Southern Railway and London & North Eastern Railway it is treated as an operating matter. On the London & North Eastern Railway, container distribution is regulated by the freight rolling stock controller in a central wagon control office, which is an « all line » organisation directing similar operations in respect of the wagon stock. This, it is claimed, is the most logical organisation, as the work is of a similar nature, duplication and circumlocution is avoided, expert distributors, direct telephonic communication and other facilities are at all times available.

London & North Eastern Railway containers are controlled individually and all their movements recorded.

Stations receiving, forwarding and having on hand, either loaded or empty, any type of container (or chassis wagon) send an advice at the close of each day direct to the central wagon control office on a special urgent train message form, giving the following information :

CONTAINER		L.N.E.R. Container Flat Wagon Numbers	ON HAND				DEPARTURE				
			ARRIVAL							IF LOADED	
Code letter	No.		Date	From	L or E	W or S	Date	To	L or E	Weight T. C.	Description of Traffic

At the central wagon control office a card is kept for each container, and upon it is recorded the movement and location of the container as revealed by the station return. The cards are segregated and nested into appropriate partitions in a cabinet in such a manner as to give an immediate visual and up-to-date indication of the container required for use and those available for distribution. The cabinet is sectionised for the reception of the cards as below :

DISTRICT	ON HAND			TO ARRIVE			LOADED OFF SYSTEM OR IN WORKSHOPS.
	Empty		Inward loaded	Required		Spare	
	Spare	Required		Loaded	Empty	Loaded or Empty	

Stations in need of containers requisition them from the subsidiary wagon control office in their district superintendent's office, which is in telephonic communication with the central wagon control office. Those required for loading from the Continent to England are ordered direct from the central office by the Continental traffic manager. The requirements are then met by the central office from the most convenient point at which containers are available for disposal.

The records as classified and maintained in the cabinet at the central office shew at a glance those containers which are away from the London & North Eastern Railway system and the visible indication ensures that they are properly supervised and not overlooked. The records on the cards further shew the dates of arrival at stations on the London & North Eastern Railway and enable effective supervision to be exercised over the terminal time.

At the bigger depots, where container traffic is considerable, daily records of containers available and supplied to traders are kept for local use. Empty containers for loading are carted or motored from the depots to traders' premises or put into private sidings, except in cases where firms elect to use their own cartage or load the container at the station. The conveyance from arrival station to consignee is effected in similar ways. From departure point to destination they are usually conveyed by rail, but sometimes urgent orders for short distances are conveyed by road.

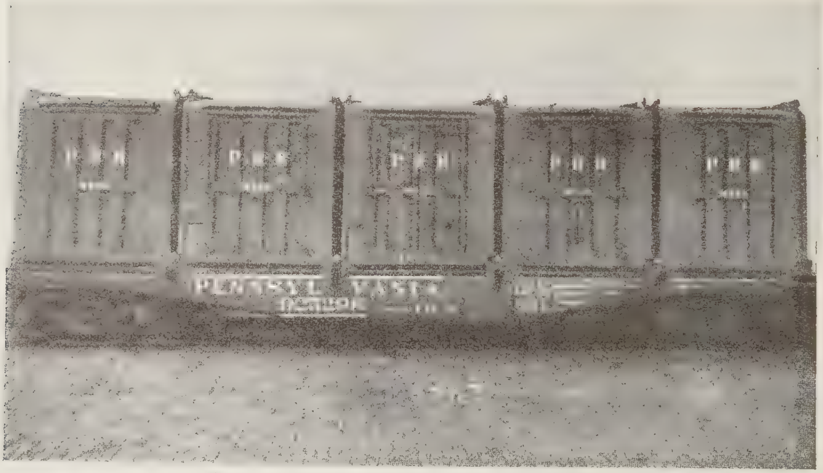


Fig. 2. — Five containers on flat wagon. Pennsylvania Railroad.

Traffic loaded in containers for delivery to more than one consignee is allowed, subject to an additional charge for each extra delivery. This and a similar regulation for the collection of traffic from more than one consignor to form bulk-loads are adopted by all Companies.

Containers are not, however, generally used for the purpose of conveying less than car load traffic. There is a minimum of one ton per container. The only exceptions are wickerwork and returned empties, for which no minimum weight is laid down.

In the United States, sectional or less than car load containers are becoming increasingly popular. In effect, a container is used as a sectionalised box car, to eliminate tranship work. These containers are generally steel constructed and handled in batteries of five or more on a specially fitted flat car. The Central Railroad of New Jersey (Reading Company) use a specially equipped car, on which can be loaded 12 containers used for bulk loads of coke and dolomite.

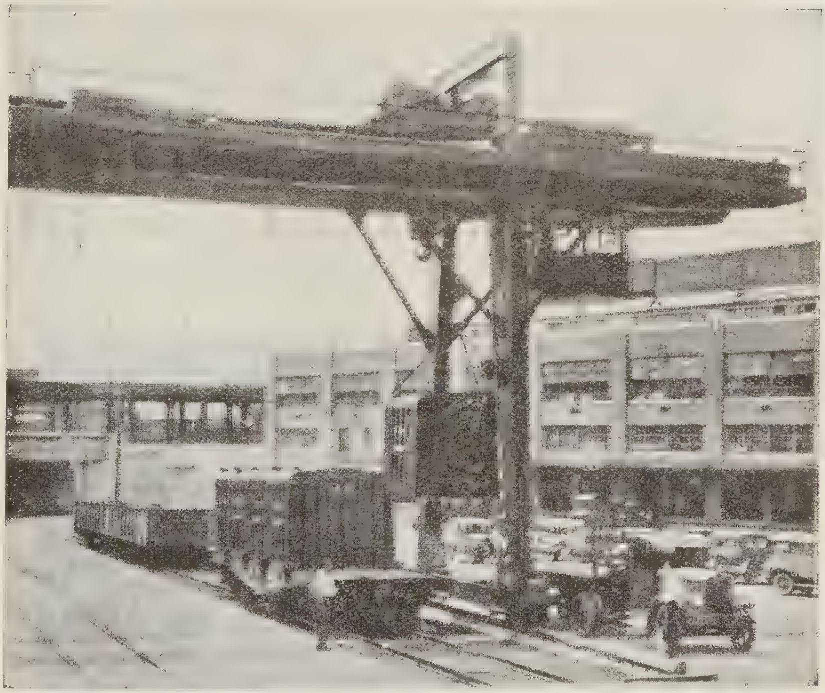


Fig. 3. — Transfer of containers, Pennsylvania Railroad.

The carrying capacity of the American container varies from 7 000 lb. to 12 000 lb., which is considerably larger than that of British containers. They can, therefore, only be considered as L. C. L. (less than carload) containers in comparison with the U. S. A. car, whose average capacity is 45 tons, or 40 equivalent British tons.

Answers to the questionnaire have failed to reveal any special organisation for the handling of these containers. It is understood, however, that the Pennsylvania Railroad Company applies some system of rationalisation to the working of their containers. Special attention is given to them at transfer stations, e.g. Enola, where they are handled by two overhead cranes. Here container loads are readjusted so that wagon movement is kept down to a minimum. If containers were not used, the traffic would require rehandling at tranship stations. Apart from a substantial saving in handling costs, the container service is said to save 24 hours in transit time, as, except where there is a specialisation on certain train movements, a minimum of 24 hours is required for freight to go through a transfer station.

It may be noted that in 1933 an International Container Bureau was set up, including representatives of both road and rail transport, to conduct a joint study of container traffic problems under the auspices of the International Chamber of Commerce.

The rail-road unit has not as yet

gained much popularity. But recently, on the Baltimore & Ohio Railroad, tests were carried out with a large van fitted with pneumatic tyred wheels, which are outside the steel flanged wheels, and are not removed when the vehicle is on the rails. The tyres are merely deflated and the front wheels locked. When the vehicle is to return to the road the tyres are inflated by the same air system as is used for braking. Apart from this one known instance, the use of rail-road wagons in the U. S. A. is confined to Companies who do not belong to the Association; e.g. The Chicago, Rock Island and Pacific Company, in conjunction with the Keeshin Motor Express Company, run a « ferry » service for truck trailers or rail-road wagons. The railroad is further used for the movement of highway trailers across Illinois if the rail rate does not exceed the cost of highway operation.

Perhaps the most interesting development in container equipment is to be found in Japan, where the smallest sized containers are recognised to be the most useful. Small size containers were first put into service by the Japanese Government Railway in 1931 : they were made wholly of steel, but lined with wood, to obviate heat conduction.

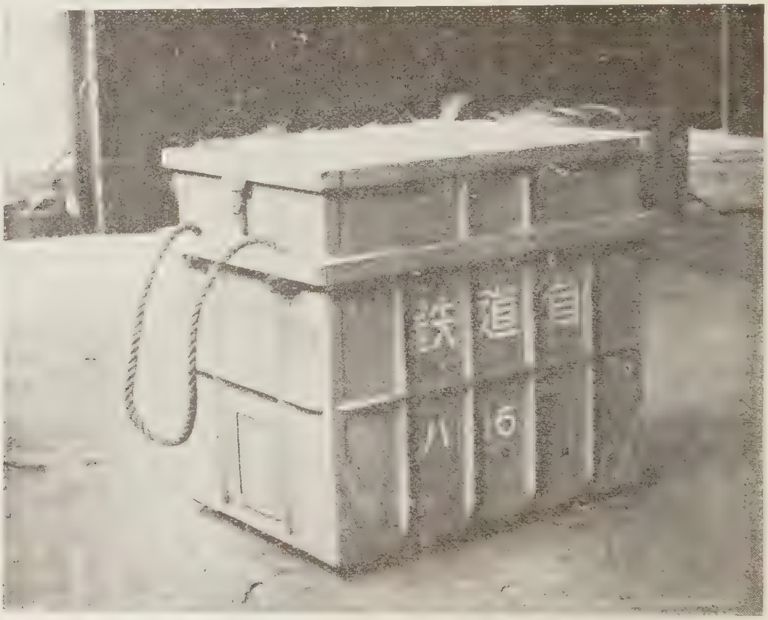


Fig. 4. — Small-size all-steel container, Japanese Government Railways.

Carrying capacity . . . = 2 337 lb.
Tare weight . . . . = 926 lb.
Minimum weight of traffic = 1 102 lb.

Length = 5′ 8 1/2″
Width = 3′ 3″
Height = 4′ 4 3/4″

In 1932, experiments were made with containers with wooden panels and iron and steel fittings, and the carrying capacity and tare weight were reduced to

331 lb. and 132 lb. respectively. The minimum weight of traffic dropped to 220 lb. It was found, however, that goods in these containers were very liable to damage. Now, containers in general use are either all steel or steel with wooden lining and have the following measurements :

Carrying capacity . . . = 331 lb.
Tare weight . . . . = 150 lb.
(new design 121 lb.)
Minimum weight of traffic = 176 lb.

Length = 2′ 6 3/4″
Width = 1′ 8 1/2″
Height = 2′ 4 3/8″

Low tare weight and durability are considered to be the essential factors in their construction.

Fibreboard and bamboo containers are being used experimentally. The latter are regarded as promising since the material is so light and can be obtained so cheaply in Japan. Sectional steel containers of different designs have also been built experimentally.

Of the traffic conveyed in these small containers, confectionery represents 80 % and the other 20 % is comprised of textile goods, silk, threads, toys, gramophones, earthenware, papers and paper products, dried fish, etc. The introduction of the small-sized container is said to have greatly stimulated the confectionery and other industries which have restored to the railways a considerable amount of traffic formerly diverted to road and water.

Unfortunately no information has been received as to the system of operating these containers in service, but the possibility of using small size containers might well be considered by other countries, as a way to minimise tranship work on a similar principle, though on a smaller scale, to that adopted by the Pennsylvania Railroad Company.

For some of the information on this subject, the Reporter is indebted to the British Railway Research Service, which placed the use of its library at his disposal.

⁂

Summary.

1. The use of mechanised appliances and automatic point operation, where they have been adopted at large marshalling yards, have secured considerable economy and speeded up the working.

Large concentration yards are not always the most desirable : the alternative is a system of sectionising at the loading point or in comparatively small yards close at hand, and the planning of train services on the basis that sections are exchanged at appropriate junctions.

2. Little comment is necessary, except that, where there is any considerable density of traffic, a control organisation is essential to efficient operation.

3. The source of information varies according to the railway organisation. It is important that such information should pass through as few hands as possible before reaching the actual operating office.

4. The arrangements for advising consignees of the arrival of goods are varied and depend on the nature of the traffic and the location of the consignee. Efforts should be made to put an end to the unfortunate practice whereby traders assure their consignees that the goods have been despatched by rail before they have been actually handed over to the railway company. Preliminary notification should not be given without making certain that the wagons can be really placed at the time fixed.

5. The initiative of the local agent

or station master should be hampered as little as possible.

Leniency in imposing demurrage charges etc., though it may be a commercial necessity, is not conducive to successful turn-over of wagons.

6. *a*) Use of containers in this zone is confined to Great Britain, the U. S. A., Japan and Australia.

b) The « rail-road » wagon has not as yet gained much popularity.

c) There is considerable room for development in the movement of low grade building material by container.

d) The effectiveness of container transport is dependent on the provision of adequate cranage facilities at terminals. The mobile crane is considered to be the most elastic unit, though at transfer stations, where there is no road access for such a unit, the overhead crane is the most suitable.

e) The possibility of using small size containers, after the Japanese style, might well be considered by other countries, as a way to minimise tranship work on a similar principle, though on a smaller scale, to that adopted by the Pennsylvania Railroad Company (U. S. A.).

[656. 27]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION VII.

Economical operation of the main-line systems' secondary lines. Various methods adopted to adjust the operating facilities, safety measures, and station organisation to the volume of traffic.

REPORT

(Italy, Spain, Portugal and Colonies, Switzerland, Austria, Hungary, Czechoslovakia, Jugoslavia, Bulgaria, Rumania, Greece, Turkey, Egypt),

by G. C. PALMIERI,
Inspecteur en Chef Supérieur du Service du Mouvement, Italian State Railways.

The operation of secondary lines is both a technical and economic problem : the aim towards which the efforts of railway technicians are devoted is, however, purely economic.

The main difficulty opposing an economical operation of lines carrying only light traffic, incorporated in large systems, arises from the fact that many secondary lines were built and worked in the first instance in the same manner as lines carrying heavy traffic, which made the charges imposed on secondary lines too onerous.

Organisation of the services on these lines must, however, be based on the necessity there is of the working method adapting itself to the more modest part these lines play, i.e., the more restricted task they are called upon to fulfil.

Methods used by Administrations for adapting the staff and equipment to the amount of traffic are the subject of our report. The detailed list of questions on this subject was sent out to 52 Railways : 23 have sent in their reply.

The following Companies replied that they had nothing to communicate :

Ferrocarril Cantabrico; National Western of Spain; Nord-Milano; Companhia Portuguesa para a construção e exploração de caminhos de ferro, Linhas do Vale do Vouga; Viège-Zermatt Railway; Yverdon-Ste. Croix Railway, and the Lausanne-Ouchy Railway.

The Bulgarian State Railways and Harbours informed us that the secondary lines of their system are worked according to the same regulations as their main-lines, because even lines only carrying light traffic are classed together with the main lines.

The same reply was given by the Management of the Greek State Railways.

The National Portuguese Railway Company stated that all its lines are local railways, and yet it had no information to give.

The Management of the Bern-Loetschberg-Simplon Railways referred us, for all information concerning them, to the reports supplied by the Swiss Federal Railways, seeing that the conditions for working secondary lines on its system are governed by the same laws and regulations. Consequently, whenever we mention in the course of our report the Swiss Federal Railways, it is understood that we also refer to the Berne-Loetschberg-Simplon Railway.

Finally, the following Administrations replied in a very detailed manner to the questionnaire :

Tte Italian State Railways; Piedmontese Tramways Company; Austrian Federal Railways; Egyptian State Railways; Northern of Spain Railways; Royal Hungarian State Railways; Portuguese Railways Company; Portuguese Government (Lourenço-Marquès) Railways; Rumanian State Railways; Swiss Federal Railways; Czechoslovak State Railways, and the Jugoslav State Railways.

We give below, for each question, the detailed replies of the above-mentioned Railways.

⁂

I. — General.

QUESTION 1. — *Is the classing of a line of your system as a secondary line the result of an act of the Public Authorities?*

Or do you designate under the name of « secondary line » all your lines carrying only light traffic?

REPLIES.

ITALY. — State Railways.

The classing of a line in the category of secondary lines may be the result of an enactment of the Public Authorities, or otherwise.

There come under the first category the so-called « Sicilian secondary or complementary » lines, and others built according to special laws; all standard-gauge lines incorporated in the main system and which were built without special limitations belong to the second category.

Sicilian secondary lines form a system which may be considered as being practically independent of the State Railways' main system; they have a narrow gauge (95 cm. = 3′ 1 3/8″) and quite particular constructional characteristics: curves of small radius, heavy gradients, light rails, etc.

ITALY. — Piedmontese Tramways Co.

The lines all carry only light traffic and are worked on the basis of regulations admitting of numerous simplifications.

AUSTRIA. — Federal Railways.

No special distinction between main lines and secondary lines is made by any act of the Public Authorities. The distinction between main lines and local lines results from the concession deed. The Supervising Authority is the Federal Ministry of Commerce and Communications.

EGYPT. — State Railways.

All lines, except main lines, are classed as secondary.

SPAIN. — Northern Railways.

The classification of any line in our system as a secondary line depends on no disposition of the Public Authorities. In our country we consider all lines only carrying a slight amount of traffic as secondary lines.

HUNGARY. — Royal State Railways.

The classing of a line in the category of secondary lines is done by decision of the Government. As a rule, there are classed in this category lines on which the maximum authorised speed is 40 km. (25 miles) for trains and 50 km. (31 miles) for railcars.

PORTUGAL. — Portuguese Railways Co.

In home traffic we call secondary lines those on which traffic is light, but there is no official document stating to which lines this designation should be applied.

PORTUGAL (Colonies). — Lourenço-Marquès Railways and Port.

No.

RUMANIA. — State Railways.

All lines carrying only light traffic are designated as secondary lines by the Rumanian Railways Administration.

SWITZERLAND. — Federal Railways.

Classification of lines in the category of secondary lines is provided for in an Order of the Federal Council.

CZECHOSLOVAKIA. — State Railways.

Our public railways are classified into groups as follows : main lines, secondary (or local) lines, light railways. The secondary lines and light railways usually have a smaller output and traffic than the main lines. Secondary lines are, on principle, railways which fulfil transportation requirements of a given, more or less extensive, district and linking such a district up with the main lines.

Light railways are of only slight importance as regards the traffic of the country as a whole and international traffic; above all, they fulfil local traffic requirements (in parishes, etc.). The question as to whether railways should be constructed, maintained and worked as main lines, secondary lines or light railways is regulated by the concession act, taking into account all circumstances, especially the importance and output of the railway. Insofar as it is used on our railways, the designation of secondary line is mostly used for local railways.

To sum up, the classification of the lines is based on the importance of the traffic. According to the category in which lines are classed in they are subject to special regulations governing the permanent way and structures, the weight of locomotives and rolling stock and train speeds.

JUGOSLAVIA. — State Railways.

In our country railway lines are classed according to the intensity of their traffic.

QUESTION 2. — *Are there, on your system, special working regulations, applicable to secondary lines, which differ from the regulations applicable to main lines, and if so :*

a) *To what extent do they alleviate the safety measures and train running regulations as applied to main lines (dispensing with signals — special conditions for announcing trains — unguarded level crossings — inspection of permanent way, etc.)?*

b) *Do they authorize a reduction of the daily hours stations are open to the public; are not certain stations only open for the forwarding and delivery of goods during train stops?*

c) *Do they allow of a reduction in the number of repairs to rolling stock running exclusively on secondary lines (passenger and goods)?*

Give as brief a summary as possible

of the principal provisions in the regulations, stating whether special measures have been imposed to offset the advantages considered under a), b) *and* c). *(Limitation of the speed or composition of the trains; as regards unguarded level crossings, the obligation to install special appliances to warn road users of the nearness of level crossings and the approach of trains; of providing special signals on the line to warn engine drivers that they are approaching a level crossing).*

Do you observe the same rules for braking of trains (passenger or goods) on secondary lines as on main lines? If not, state the principal differences.

REPLIES.

ITALY. — State Railways.

For the secondary lines of our main system there are no special working regulations allowing any attenuation of prescriptions concerning safety measures and regulations regarding the running of trains on main lines. Nor is there any reduction allowed in the daily opening hours of stations to the public and in the number of periodical repairs to rolling stock running on secondary lines; besides there is, as a rule, no rolling stock used solely on lines carrying light traffic. On secondary lines level crossings are all guarded or closed by gates : no speed limit is fixed for trains, but a limit is, in effect, imposed by the condition of the track.

As regards secondary lines in Sicily, the working conditions are different. The regulations are simplified; stations usually have no home signals but simple marker posts, communications being ensured by telephone.

Most of the stations are not staffed by permanent railway employees; their management is entrusted to private persons, bound to the railway by contracts. Stations which are managed by permanent railway staff (control stations) are responsible for train running on a given section of line and decide changes of crossing, alterations in the succession of trains, the running of optional trains, etc.

In unguarded stations or simple stopping points, traffic is regulated by the guard : in case of crossing, the entry of trains is done according to the actual succession, viz. the first train to enter is the one which arrives first. The guard of the first train, as soon as he arrives, fulfils the functions of train controller and admits the second train.

Trains running on a section of line are classed according to their importance : each train is defined as being more or less important in relation to all other trains running at the same time on the same section of line. Consequently, in case of delay, if an operating station does not intervene, the guard acting on the more important train gives direct orders for the crossing or overtaking to the guards of the less important trains.

This operating method may be considered as a much simplified dispatching system, without the use of costly technical means.

All telephonic communications are regularly recorded in telephone books : traffic is regulated by the timetables and in certain cases the spacing of trains is ensured by the warning given of the arrival of the previous train. In case of crossing, the two trains have to stop before entering the station; the first train always enters on the left hand track. There is no speed limit for trains except that necessitated by the nature of the track; no attenuation is authorised as regards train braking.

ITALY. — Piedmontese Tramways Co.

Working regulations are adapted to the special service on the lines and admit of several attenuations as regards signalling and train running.

Fixed signals used are red discs for indicating a stop; at night, a red light.

The running of trains is regulated by the timetables; communications are ensured by telephone or telegraph. All vehicles, whether passenger or goods, are fitted with Westinghouse brakes.

The spacing of trains is regulated by a provision stating that a train which follows another is not to approach the preceding one nearer than 500 m. (550 yards). Crossing at other than scheduled points is done in the usual manner, and crossing can even be made to take place in a locality that has no telegraph nor telephone but in any case agreements for changes of crossing places must, however, be made between stations staffed by railway employees.

AUSTRIA. — Federal Railways.

Our working regulations are common to both main lines and local lines because this gives us the means of making a better use of our staff. Attenuations of the regulations in force on main lines are authorised, and are as follows :

a) the use of bells to warn of the departure or arrival of trains is not obligatory;

— home signals are only fitted if they are recognized as being necessary by the Supervising Authorities;

— caution signals are not lighted at night if the maximum speed of trains does not exceed 40 km. (25 miles) an hour.

— wagons are allowed to stand on the open track for the purpose of loading and unloading only when the gradient does not exceed 1 in 67. Certain precautions are laid down. Attenuations are also allowed for the running of track-inspection trolleys.

b) There are no exceptions to the rule.

c) As our rolling stock invariably runs on both main and secondary lines, no difference is made as regards maintenance.

The distance for braking trains is 700 m. (770 yards) on main lines and 400 m. (440 yards) on secondary lines. Consequently, for the latter lines we allow a different proportion of manned brakes.

EGYPT. — State Railways.

No attenuation of safety and running regulations.

No reduction of daily opening-hours of stations to the public. No reduction in the number of inspections of rolling stock. The same braking rules are in force as on main lines.

SPAIN. — Northern Railways.

The Company has no special running regulations for secondary lines, which are worked on the same principles as main lines. The regulations or modifications which have been adopted, and which are of general application, with a view to obtaining more economical working, have been much more easily applied to secondary lines because of the lighter traffic they carry.

a) No simplification of the regulations as regards announcing trains, but a simplified signalling in view of lighter traffic.

For the sake of economy the line service is abolished when there are no passenger trains running during the night; level crossings may remain open after the passage of the last train in the evening till the passage of the first train next morning (a bye-law prescribes that in such instances the inspector of services must make the line service aware of any special traffic circulating, so that steps can be taken to protect level crossings). The gate-keepers do 8 hours duty a day, with ample rest time in between. The permanent way is overhauled every 3 years whereas in the case of main lines this period is 2 years.

b) Working hours in stations are divided into 3 shifts of 8 hours each. With a view to general economical organisation, stations on main lines may also perform an intermittent service by suppressing one shift a day. On secondary lines we have obtained still more satisfactory results. For passenger services we have lines worked by two 8-hour shifts, and on these same lines there are even stations which restrict their service to only 8 hours. For goods traffic the stations only remain open 8 hours (from 8 a. m. to 1 p. m. and from 3 p. m. to 6 p. m.).

Special dispositions give us the faculty of modifying the working hours in stations, in order to better adapt them to requirements and to reduce them, on occasion, to a period of 5 1/2 or 6 hours in the case of goods traffic.

Finally, we have stations that are only open when trains arrive, for accepting and forwarding goods, and then only if we have a person qualified to carry out such operations when trains pass, some restrictions being then in force as regards the nature and weight of the goods.

c) We have made no essential changes in regulations nor adopted special measures for the telephonic communications at stations which carry on an intermittent service. The suppression of gatekeepers at level crossings is authorised according to prescriptions issued by the Public Authorities, the installation of special signalling (see sketch) for warning road users of the existence of an unguarded level crossing being compulsory in such cases. Signals are also placed on the line at 600 m. (660 yards) from the crossing to warn drivers that they must whistle.

There is no difference as regards braking of trains between secondary lines and main lines.

HUNGARY. — Royal State Railways.

The regulations in force on main lines also apply as a rule to secondary lines; nevertheless, certain attenuations are authorised for secondary lines.

a) They are as follows :

— simplification of track and train signals;

— acceptance of certain kinds of traffic without special formalities;

— certain operations (loading and unloading may take place on the open line;

— use of train staff for shunting duties.

b) In loading-halts on lines carrying only light traffic, for the handling of consignments from one or several clients, the acceptance or delivery of consignments is done by train staff while the train is stopped. The book-keeping however, is done at a neighbouring station.

The braking distance for trains is 700 m. (770 yards) on main lines and 400 m. (440 yards) on secondary lines.

PORTUGAL. — Portuguese Railways Co.

They do not exist. Traffic regulations are the same.

Although there are no special regulations, signalling is restricted to the use of an advanced permissive signal (a red disc) at each end of stations. There are also level crossings which are unguarded; we sometimes use signboards to draw the attention of the public before getting over crossings.

Braking regulations are the same as on main lines.

PORTUGAL (Colonies). — Lourenço-Marquès Railways and Port.

No.

a) Signals are dispensed with. Trains are announced by telephone in many instances. Level crossings are unguarded except at exits of stations.

b) We run as few passenger and goods trains at night as possible. Consignments are accepted up to 5 p. m.

c) No. There is no rolling stock intended only for use on lines carrying only light traffic, so that there is no attenuation as regard the interval between periodical rolling stock repairs.

On most of the lines, even those carrying light traffic, the average speed is 37 km. (23 miles). We have imposed no special precautions at level crossings, except in the neighbourhood of large towns, because road traffic is only light.

Braking rules are the same as on main lines.

RUMANIA. — State Railways.

No, but on certain secondary lines the running of trains is controlled by dispatching, which means a saving in staff at stations.

SWITZERLAND. — Federal Railways.

There is a Federal law and a Federal ordinance concerning the construction and working of Swiss secondary lines. They only apply to railways on which the maximum speed does not exceed 65 km. (40.4 miles) an hour.

a) The facilities granted mainly concern structures, signals and barriers.

b) No, if exceptions to the general rule are necessary they are granted in each special instance by the Department of Railways.

c) Our rolling stock invariably runs on main- and secondary lines : no difference is consequently made as regards periodic repairs.

The speed of trains must not exceed 65 km. (40.4 miles) an hour. Home signals : these signals are enforced when the speed of trains exceeds 40 km. (25 miles) an hour at transfer or junction stations and, in addition, at crossing stations when the speed exceeds 55 km. (34.2 miles). Distant signals are only required when visibility is really bad.

As regards level crossings, see illustrations, figs. 9 to 14.

As far as the remaining points are concerned, the secondary lines of our system are worked (including braking of trains) in the same manner as our main lines.

CZECHOSLOVAKIA. — State Railways.

a) The local railways are allowed certain facilities for their working, laid down by special prescriptions notably in connection with : the guarding of level crossings, the announcing of trains, track and train signals, the composition of trains, braking rules, train staff.

Nearly all the lines in question are motorised, at any rate partially (passenger traffic), which has enabled us to separate passenger traffic from goods traffic and accelerate the former. Most of the lines are fitted with telephone appliances and some of them with telegraphic apparatus.

b) At roadside halts only open to passenger traffic the daily service is not continual but is appropriated to this traffic. The other stations (halts with loading platforms), at which the forwarding of goods is also done, are open to the public from 8 a.m. to noon and 2 to 6 p.m.

c) The overhaul interval prescribed for passenger coaches, postal vans and baggage vans running on local railways is 2 years, whilst for vehicles running on main lines it is 18 months (for local trains).

The period between overhauls of goods wagons is the same on secondary lines as on main lines.

As a rule, it is not necessary to reduce speed at level crossings. It is only in quite exceptional cases, depending on local circumstances, that the speed has to be reduced or barriers fitted.

Road users are warned of level crossings by fixed signs or by the whistling of trains at places where the prescribed visibility does not exist. No special signalling apparatus is used to give warning of the approach of trains at level crossings.

JUGOSLAVIA. — State Railways.

From a commercial standpoint the regulations applicable on secondary lines are the same as those applied on main lines.

We have one set of working regulations, with alleviations in favour of secondary lines.

a) The principal alleviations are :

1. some signals are simplified; audible signals (electric bells) are abolished;

2. telegraph service is restricted;

3. level crossings are not guarded;

4. inspections of permanent way are less frequent.

b) The daily opening-hours of stations are the same as on the main lines.

c) Rolling stock running exclusively on secondary lines is subject to the same periodical overhauls as rolling stock on main lines. The speed is restricted to 40 km. (25 miles) an hour.

As regards unguarded level crossings, see question 13.

The braking-distance on secondary lines is 400 m. (440 yards), whereas on main lines it is 700 m. (770 yards).

QUESTION 3. — a) *Is the working of your secondary lines done by services distinct from those which work the remainder of your System?*

b) *Have you entrusted the working of your secondary lines to private undertakings (Light railways, tramway companies, other transport undertakings, etc.)? If so, state more interesting conditions of contracts made with such undertakings; are the latter interested in the working results?*

REPLIES.

ITALY. — State Railways.

a) No.

b) The Sicilian complementary lines and others carrying only light traffic are worked direct by the State Railway Administration.

ITALY. — Piedmontese Tramways Co.

We work our own system.

AUSTRIA. — Federal Railways.

a) and *b*) No.

EGYPT. — State Railways.

The working of our secondary lines is not distinct from that of our main lines.

We own 51 % of the shares of the Omnibus Companies.

SPAIN. — Northern Railways.

All regulations in force tend to economical working. Consequently they have been applied easily to the secondary lines.

No secondary line has been handed over to be worked by a private undertaking.

HUNGARY. — Royal State Railways.

The working of secondary lines is carried out by the same services as those which work the main lines. We do not entrust it to any private undertaking.

PORTUGAL. — Portuguese Railways Co.

PORTUGAL (Colonies). — Lourenço-Marquès Railways

and **RUMANIA. — State Railways.**

a) and *b*) No.

SWITZERLAND. — Federal Railways.

No, with the exception of two secondary lines of a length of 5 and 6 1/2 km. (3.1 and 4 miles) respectively which have been entrusted to private railway companies. These concerns bear all the working costs and, on the other hand, take all the receipts.

CZECHOSLOVAKIA. — State Railways.

In Czechoslovakia the railways are State concerns, whether main lines or secondary lines. A Governmental decision stipulated, 12 years ago, that all local railways were to be handed over to the State in 3 stages. At the present time we still have a certain number of secondary lines which are owned and worked by private railway companies, under the supreme supervision of the State Railway Administration. Nevertheless, most secondary lines are operated by the State Railway Administration against payment of its expenses. On private railways worked by the State the owners of the railways take a share in the profits.

JUGOSLAVIA. — State Railways.

Secondary lines are worked by the same services as those that work the main lines. We do not entrust the working of any of our lines to private undertakings.

II. — Methods of transport used.

QUESTION 4. — *Do you use on secondary lines, for passenger, goods and mixed trains (passenger and goods), motive power having special characteristics :*

— Steam engines of a particular type or having undergone considerable transformation as compared to engines of the current type (appliances facilitating loading of fuel into the firebox, etc.) — diesel-engined locomotives — locotractors — railcars?

If so, please supply the details requested in the 2 appended tables. Indicate briefly the results obtained from the various traction methods used on secondary lines, especially since 1930, as regards : reduction of driving and train staff; reduction of cost price per train-mile; increase of average speed, etc.

REPLIES.

ITALY. — State Railways.

On our secondary lines we do not use any motive power having special characteristics, except rack engines on very steep gradients.

Nor do we use any diesel-engined locomotives or tractors. But we have railcars in service, on both main lines

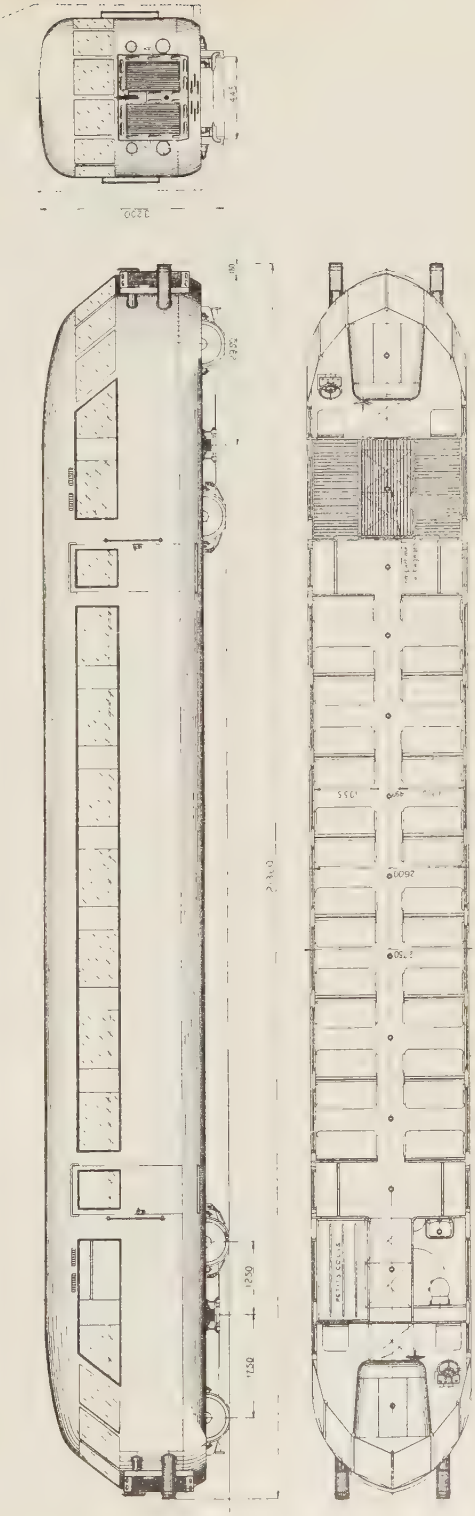


Fig. 1. — 56-seat diesel railcar, Italian State Railways.

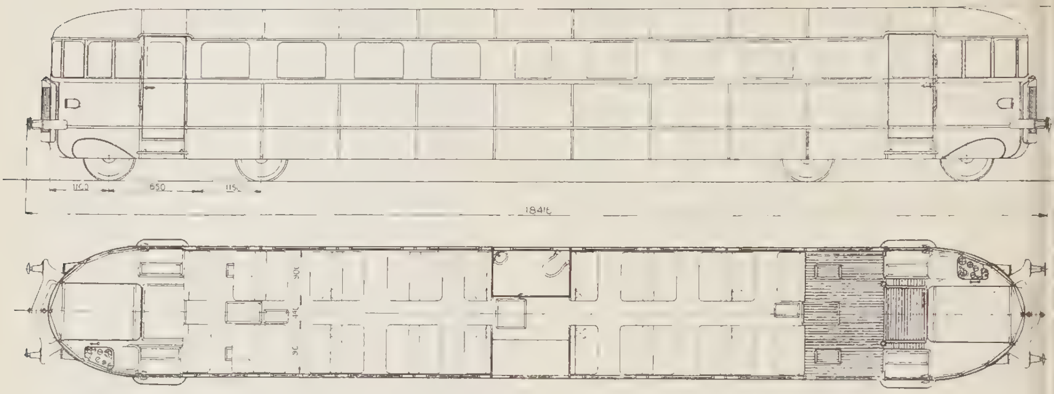


Fig. 2. — 56-seat diesel railcar, Italian State Railways.

and secondary lines. *(See Table I hereafter).*

As a result of the use of railcars — used on a large scale in our country — on secondary lines we have achieved a very considerable saving in driving staff and train staff, as our railcars are driven by one employee and have one guard.

The saving effected cannot be expressed in figures because railcar services are run both on secondary and main lines and because we have considerably increased the number of trips on secondary lines as a result of the saving effected.

The cost price per train-kilometre has dropped to about 2.80 lire including maintenance charges, whilst the average speed has been increased by 30 %.

ITALY. — Piedmontese Tramways Co.

The service is carried on by electric accumulator-driven railcars. The technical and economic results obtained are very satisfactory, and we think it may be of interest to give below the characteristics of these vehicles :

Length over buffers.	13.80 m.	(45′ 3 5/16″)
Width of body . .	2.25 m.	(7′ 4 5/8″)
Maximum width . .	2.30 m.	(7′ 6 9/16″)
Height above rails .	3.325 m.	(10′ 11″)
Maximum height .	3.600 m.	(11′ 9 3/4″)
Total weight	29 tons.	

The body is carried on two 4-wheeled bogies; the wheels have a diameter of 800 mm. (2′ 7 1/2″). The electrical equipment is made by the Tecnomasio Italiano Brown-Boveri, of Milan.

Tractions motors.

4 motors of the self-ventilated series-excited type with commutating poles :

Voltage at terminals : 300.

Hourly capacity at the axle of each motor : 30 kv. for about 41 H.P.

Corresponding speed at this power : 600 r.p.m.

Gear ratio : 1 : 5.2.

Controller.

For putting the 4 motors into circuit we have a controller of special construction with a coil spark extinguisher for each switch and separate handle for reversing the running and cutting out one motor in case of need.

There is an appliance for gradual electric braking.

Braking.

Action of the Westinghouse brake and its sand spraying devices is obtained by means of an independent motor-compressor.

Accumulator battery.

The accumulator battery consists of 160 cells having a capacity of 800

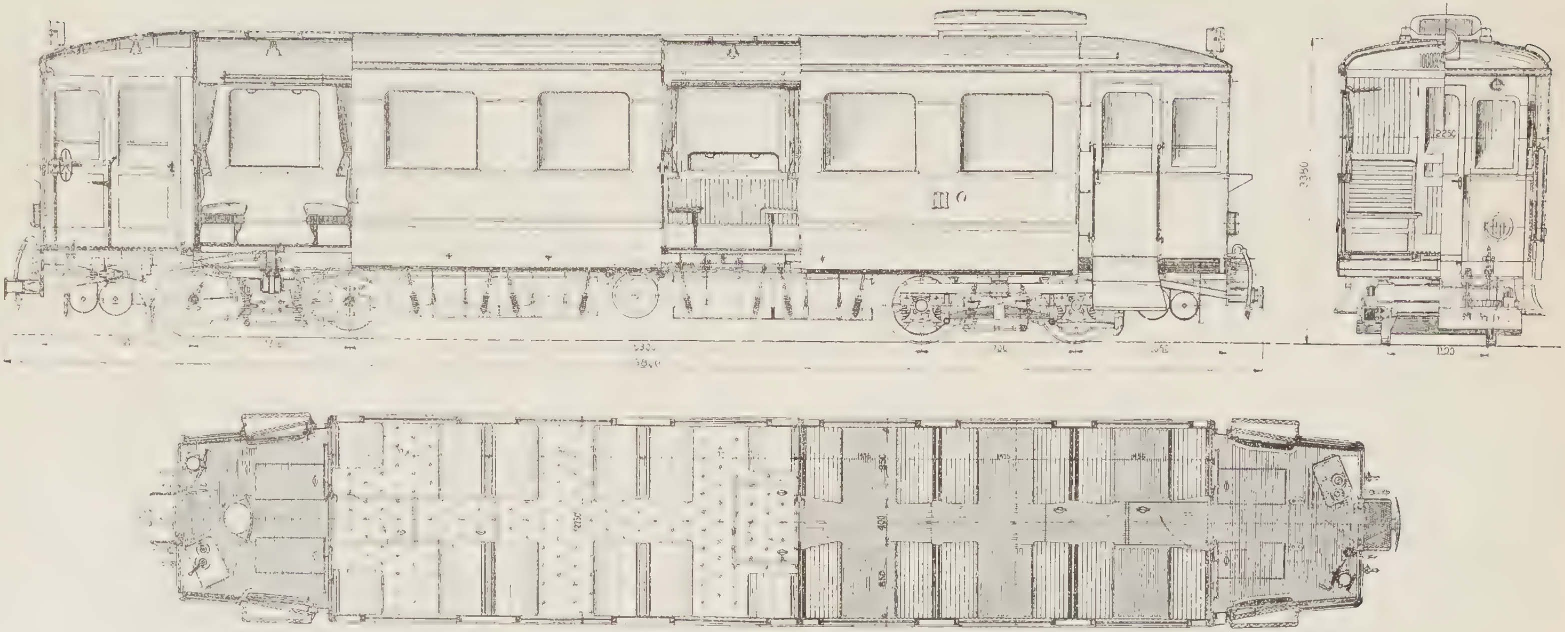


Fig. 3. — Electric accumulator railcar, Piedmontese Tramways Company.
Passengers carried : first class, 20 seated; third class, 26 seated; 24 standing.

amp./h. at a 5-hour discharge rate (equivalent to 240 kw.-h., the average discharge voltage being 300).

After adoption of this type of railcar the driving staff was reduced by 50 %; the cost price per train kilometre dropped to about 1.60 lire; the average speed was increased from 24 to 36 km. (15 to 22.4 miles) per hour.

AUSTRIA. — Federal Railways.

No reply because rolling stock is used indiscriminately on main- and secondary lines.

EGYPT. — State Railways.

Besides steam trains, we have in service on our secondary lines steam railcars and Ganz diesel railcars.

The working results have been satisfactory and on certain lines of restricted length the number of runs has increased, with resultant great facilities to passengers on the said lines.

SPAIN. — Northern Railways.

The steam engines running on our secondary lines have had no alterations made in their parts or characteristics. We have neither diesel locomotives nor locotractors in service.

The railcars which we have in service are those mentioned in Table II.

The introduction of railcars has enabled us to reduce the staff to one driver and one guard.

The commercial speed of trains hauled by steam engines was about 25 km. (15.5 miles) per hour, whereas that of the railcars is about 40 km. (25 miles).

HUNGARY. — Royal State Railways.

The information concerning vehicles for goods and passenger traffic on secondary lines is comprised in the appended tables.

There has been no reduction in staff on steam locomotives. Railcars are staffed by one single employee. The average commercial speed has increased from 16.8 km. (10.4 miles to 37.9 km. (23.5 miles) per hour.

PORTUGAL. — Portuguese Railways Co.

On our secondary lines we do not use any steam locomotives of a particular type or having been converted from the current type.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

On our secondary lines we use railcars but not steam locomotives of a particular type.

RUMANIA. — State Railways.

We use :

— Rack locomotives of the A.p.t. system ;

— Locomotives fitted with a special device for taking curves of a radius as small as 114 m. (374′);

— « Westinghouse » and « de Dion-Bouton » railcars, with an electric transmission, of 60, 70 and 90 H.P. ;

« Sentinel-Cammell » steam railcars of 100 and 200 H.P.;

— « Malaxa » railcars ordered in 1934, 1935 and 1936 and 100-H.P. and 120-H.P. petrol railcars with mechanical transmission;

– « Malaxa » and « Astra » diesel railcars of 120/150 H.P. with mechanical transmission;

— « de Dion-Bouton » locotractors for shunting.

SWITZERLAND. — Federal Railways.

On our non-electrified secondary lines no other locomotives are used than what are used on main lines for the same traffic. No appreciable alterations have been made to these locomotives.

2 light diesel-mechanical railcars of the S. L. M. (Swiss Locomotive Works, Winterthur) system have been in service since 1st January 1936. They are staffed by one driver and usually one

guard. So far, it is not possible to give indications as to the reduction in cost price.

The average speed of steam trains is 40 km. (25 miles), that of the diesel railcars 48 km. (30 miles); the rise in speed is therefore 20 %.

CZECHOSLOVAKIA. — State Railways.

We have no special types of diesel locomotives in use. As regards railcars, see Table II.

By the motorisation of secondary lines we have achieved economy of staff by using personnel of a lower grade than those qualified to drive steam locomotives and by introducing a one-man service. Savings of fuel in motor traction are especially affected by the reduction in the dead weight of trains. By motorising the traffic the commercial speed of trains on secondary lines has been, on the whole, considerably increased.

JUGOSLAVIA. — State Railways.

On secondary lines we use for passenger trains steam locomotives of the light type as well as petrol railcars and diesel-electric cars having the characteristics mentioned in the two appended tables.

QUESTION 5. — a) *State the aggregate length of secondary lines on which there are used the various traction methods described in your reply to the previous question (question 4).*

b) *State, if possible, for each method the number of train-kilometres (or train-miles) run each day.*

c) *State the percentage which these figures represent in proportion to the total number of train-kilometres or train-miles run each day on your System.*

REPLIES.

ITALY. — State Railways.

a) 1 544 km. (959 miles).

b) Aggregate distance run each day

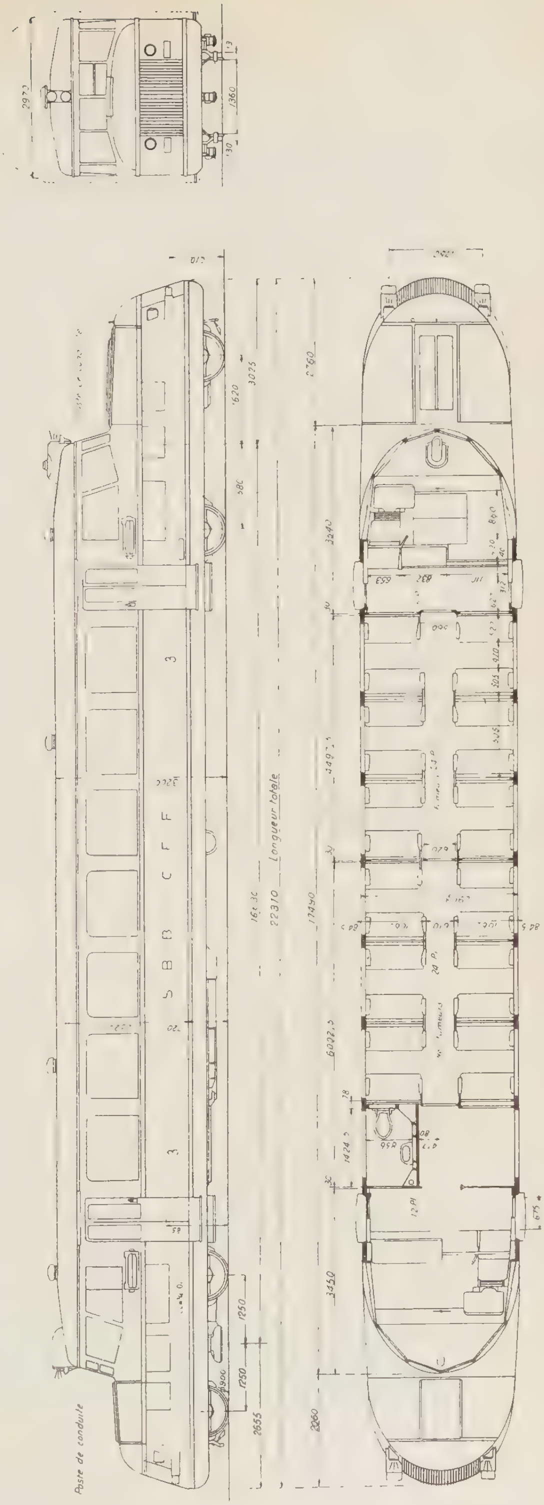


Fig. 4. — Type CLm 2/4 light diesel railcar, Swiss Federal Railways.

by railcars in service : 11 807 km. (7 337 miles).

c) Percentage compared to train-kilometres run on whole system : 4.73.

ITALY. — Piedmontese Tramways Co.

a) 120 km. (75 miles) worked by electric traction (passenger traffic);

120 km. (75 miles) worked by steam traction (goods trains);

b) About 400 000 tr.-km. (250 000 train-miles) run by railcars per year;

About 350 000 tr.-km. (217 500 train-miles) run by steam locomotives.

AUSTRIA. — Federal Railways.

No reply.

EGYPT. — State Railways.

a) The length of lines on which steam railcars and diesel railcars are in service is 5 150 km. (3 200 miles).

b) Ordinary trains : 38 000 km. (23 600 miles);

Steam rail motor cars : 4 000 km. (2 500 miles);

Diesel rail motor cars : 1 150 km. (715 miles).

c) Percentage : 13 %.

SPAIN. — Northern Railways.

a) 379 km. (235.5 miles) of which : 316 km. (196.5 miles) with petrol railcars;

63 km. (39 miles) with diesel railcars.

b) Distance covered per day :

Petrol railcars : 1 616 km. (1 040 miles);

Diesel railcars : 252 km. (156.6 miles).

c) Percentage : 4.23 %.

HUNGARY. — Royal State Railways.

Traction by railcars on 2 401 km. (1 492 miles) of secondary lines. Daily run : 10 619.6 km. (6 600 miles); Percentage : 7.76 %.

PORTUGAL. — Portuguese Railways Co.

No reply.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Our lines cannot be called « secondary lines » but rather « penetration lines ».

The number of train-kilometres per day varies much from one line to another.

RUMANIA. — State Railways.

Rack locomotives run over 77 km. (47.8 miles) of track.

Locomotives equipped for running on sharp curves are used on 33 km. (20.5 miles) of line.

Westinghouse and de Dion-Bouton railcars run over 382 km. (237.4 miles), the Sentinel-Cammell steam cars over 119 km. (74 miles).

The Malaxa and Astra railcars over 2 814 km. (1 748 miles).

SWITZERLAND. — Federal Railways.

The secondary lines of the Swiss Federal Railways total 412 km. (256 miles), of which 141 km. (88 miles) are electrified and 271 km. (168 miles) are still worked by steam.

The light diesel railcar covers, when in regular service, 550 km. (342 miles) per day.

Train-km. *(train-miles)* per day on electrified lines : 2 700 km. *(1 678 miles)*;

Train-km. *(train-miles)* per day on steam-traction lines : 6 150 km. *(3 822 miles)*.

Total distance covered per day on the whole of our system : 110 000 km. *(68 350 miles)*.

CZECHOSLOVAKIA. — State Railways.

Total length of local railways on which motor traction has been introduced : 3 800 km. (2 361 miles).

Daily average per railcar : 180 km. (112 miles).

Number of train-km. *(train-miles)* worked by motor traction : 23 292 638 *(14 672 000)* viz. 18.55 % of all the train mileage.

8 220 400 train-miles (12 909 905 tr.-km.), i.e. 55.42 of the whole motor-vehicle-miles was covered on the secondary lines, and 6 451 600 train-miles (10 382 733 tr.-km.), or 44.58 % of the aggregate motor-vehicle-miles was run on the main lines (See table II).

JUGOSLAVIA. — State Railways.

	a) Length of lines.		*b*) Daily distance run.		c) Percentage.
	Km.	*Miles.*	*Km.*	*Miles.*	
Light locomotives . .	498	309.4	2 485	1 544.0	0.0069
Diesel-electric railcars	185	115.0	1 305	811.0	0.0036
Petrol railcars . . .	105	65.2	185	309.4	0.0005

QUESTION 6. — a) *Is there, on your locomotives or railcars which are driven by a single man, an appliance which automatically stops the vehicle in case anything happens to the driver, such as the dead man's handle, for instance)?*

b) *If not, are you obliged to have on the train a second man who has access to the driver's cab?*

REPLIES.

ITALY. — State Railways.

a) We have no appliance of this kind.

b) In case anything happens to the driver, the guard must be able to proceed to the driver's stand and stop the railcar.

ITALY. — Piedmontese Tramways Co.

Same reply as the State Railways.

AUSTRIA. — Federal Railways.

a) Yes, except on a few railcars of old types which run at low speeds.

b) On self-propelled vehicles driven by a single man the guard must be given access to the driver's cabin in order to stop the vehicle in case of need.

EGYPT. — State Railways.

a) No. All rail motor cars are driven by two men.

SPAIN. — Northern Railways.

a) Yes. We have fitted the « dead man's handle » on all rail motor cars in service.

HUNGARY. — Royal State Railways.

a) Our railcars are not fitted with the « dead man's handle ». The guard has to stop the railcar in case of need.

PORTUGAL. — Portuguese Railways Co.

a) We have no engines driven by a single man.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

a) and *b*) No.

RUMANIA. — State Railways.

We have an apparatus for stopping trains automatically in case anything happens to the driver, but as it is not practical it is not used. But even if this appliance does not exist, we are not obliged to have on a train a second employee who can have access to the driver's cabin.

SWITZERLAND. — Federal Railways.

a) The two light railcars are equipped with a « dead man's handle » appliance of the Brown-Boveri & Co. system, and a « Signum » apparatus for automatically stopping trains at signals, at « danger » like all the motor vehicles running on our electrified main lines and driven by a single employee.

CZECHOSLOVAKIA. — State Railways.

a) An appliance automatically bringing a railcar to a standstill in case anything happens to the driver only exists on railcars used for fast or express trains running on our main lines. All trains can be stopped by means of the emergency brake.

JUGOSLAVIA. — State Railways.

a) On our diesel-electric railcars a « dead man's handle » is fitted.

b) On the other railcars we have no second employee who has to stop the train when the driver fails.

QUESTION 7. — a) *Have you made any alterations to passenger coaches or luggage vans running on secondary lines in order to :*

b) *Reduce the number of passenger classes or creating one single class?*

c) *Provide access, whilst the train is running, from the coach to the engine?*

d) *Reduce as much as possible the dead weight hauled?*

REPLIES.

ITALY. — State Railways.

a) No.

b) Our railcars usually have one single class.

c) No.

ITALY. — Piedmontese Tramways Co.

a) No.

It is possible to pass from one coach to another.

AUSTRIA. — Federal Railways.

a) No.

b) Some of our passenger trains have only one class : 3rd.

c) Not yet, except a quite recent type of railcar which is now being tried out and can be compared to a locomotive.

d) We have on trial new railcars which have room for luggage.

EGYPT. — State Railways.

a) No.

b) On the Helwan line the diesel railcars have only 1st class accommodation, and on the Cairo-Suez direct line, 1st and 2nd class.

c) No.

d) No.

SPAIN. — Northern Railways.

a) The alterations made are as follows :

b) In view of the smaller capacity of the railcars, they have only two classes : 2nd and 3rd, instead of three.

c) No.

d) We have increased the number of composite coaches, in order to reduce as much as possible the weight hauled.

HUNGARY. — Royal State Railways.

a) Vehicles running on steam trains on secondary lines have undergone no alterations. On the contrary, the construction of railcars and their trailers, which run in large numbers on our secondary lines, is essentially different from coaches on steam trains.

b) The number of classes has been reduced on main lines and local lines; local trains only very rarely have a 1st-class coach, and many 1st-class coaches or compartments have been converted into 2nd class.

c) No access to the locomotives. Most of our railcars have a gangway leading to the trailer.

PORTUGAL. — Portuguese Railways Co.

a) to *d*) No.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

a) Yes. We have altered one-class coaches into three-class vehicles having a side corridor and separate entrances.

RUMANIA. — State Railways.

a) On introducing railcars, the 1st-class was abolished.

c) and *d*) No.

TABLE I. — Light steam locomotives. — Steam railcars.

Types.	Year put into service.	Number.	Kind of fuel.	Grate area.	Heating surface		Boiler pressure.	Wheel diameter		Cylinder bore.	Piston stroke.	Horse-power.	Weight		Load hauled on level track.	Maximum hourly speed on level track.	Cost price per kilometre.	Average daily kilometrage (or mileage).	Driving staff. Number.	Railcars															REMARKS.
					Firebox.	Tubes.		driving.	carrying.				total.	adhesive.						Name of builder.	Overall length.	Weight, empty.	Passengers carried per class		Goods compartments			Driver's compartments		Driving staff.	Buffing gear.	Brakes.	Total cost price per km. (per mile)*	Are railcars reversible?	
																							Seated.	Standing.	Number.	Floor area.	Loading capacity.	Number.	Location.						
ITALY. — State Railways.																				Light steam railcars are being built and will be tried as soon as they are ready for service. — No other data are available.															
EGYPT. — State Railways.																																			
				sq. ft.	sq. ft.	sq. ft.	lb./sq. in.						tons	tons		m.p.h.		km.				tons					sq. ft.								
Single unit	1927	1	Coal	4.12	23.75	47.2	275	3′ 6″	2′ 9 1/2″	7″	10″	100	30.5	19.3	...	45	...	200	2	Clayton	58′ 7 1/4″	27.25	16 (II) 49 (III)	...	None	...	...	2	front and rear	1 driver 1 fireman	2 buffers at each end	Automatic vacuum brake	...	Yes	Secondary lines.
Two vehicles	1928	5	»	6.68	42	92 and 19 sq. ft. (superheater)	275	3′ 6″	2′ 9 1/2″	5″	8″	150	49.1	23.2	...	do.	...	293	2	»	100′ 4″	46.1	16 (II) 98 (III)	...	1 luggage 1 locker	...	29 10.85	2	do.	do.	do.	do.	...	»	»
Two vehicles	1930	5	»	»	»	»	»	»	»	5″	8″	»	52.12	28.8	...	do.	...	206	2	Birmingham	100′ 4″	49.125	20 (I) 24 (II) 65 (III)	...	do.	...	46.5 30.61	2	do.	do.	do.	do.	...	»	»
Two vehicles	1930	6	»	»	»	»	»	»	»	5″	8″	»	52.5	28.25	...	do.	...	203	2	»	»	49	16 (II) 95 (III)	...	do.	...	41.35 11.54	2	do.	do.	do.	do.	...	»	»
Single unit	1930	2	»	»	»	»	»	»	»	5″	8″	»	37.5	12	...	do.	...	190	2	»	58′ 10 1/4″	33.7	8 (II) 39 (III)	...	do.	...	58.38	2	do.	do.	do.	do.	...	»	»
Two vehicles	1935	10	»	12	393 sq. ft. + 135 sq. ft. (superheater)		335	2′ 9 1/2″	»	6″	7″	320/350	65.014	26.625	...	64	...	268	2	Sentinel Cammell	110′ 6″	58.67	16 (II) 98 (III)	...	do.	...	44.4 42.96	2	do.	do.	do.	do.	...	»	»
HUNGARY. — Royal State Railways.																																			
				m^2	m^2	m^2	kgr./cm²	millim.	millim.	millim.	millim.		tons (metr.)	tons (metr.)	tons (metr.)	km./h.	Fillér																		
11	1910	9	Coal	0.78	5.03	23.50	14	1 040	875	260	400	200 ind.	19.13	9.51	100	60	107.36	76	2																
22	1928	104	»	1.25	5.5	43.70	14	1 220	875	355	460	350 ind.	35.90	20.05	130	70	85.51	154	2																
PORTUGAL (Colonies). — Lourenço-Marquès Railways.																																			
				m^2	m^2	m^2	kgr./cm²	millim.	millim.	millim.	millim.		tons (metr.)	kgr.	tons (metr.)	km./h.																			
0-6-4 *(a)*	1903	12	Coal	1.44	7.4	80	10	1 310	810	430	630	475	46	31 400	800	55	...	...	2	No steam railcars.															*a)* Used on secondary lines of Lourenço-Marquès system; *b)* Used on the Mozambique system; *c)* Used at Inhambane; *d)* Used at Quelimane.
0-6-4 *(b)*	1903	3	Wood	»	»	»	»	»	»	»	»	»	44	»	»	»	...	...	2																
2-6-2 *(a)*	1936	2	Coal	2.2	9.4	106.4	12	1 350	800	505	560	535	48	34 500	1 050	70	...	...	2																
2-6-2 *(b)*	1936	2	Wood	»	»	»	»	»	»	»	»	»	»	»	»	»	...	...	2																
2-8-2 *(a)*	1924	4	Coal	3.27	12.9	159	12.6	1 219	830	483	609	950	69.3	53 450	1 500	60	...	...	3 (1 native)																
2-8-0 *(c)*	1922	2	Wood	1.5	9	104	12	1 100	750	320	550	400	39.7	33 800	600	47	...	...	2																
2-8-0 *(c)*	1930	1	Wood	1.82	8.3	93.5	12	1 150	750	410	550	430	40	33 800	650	50	...	...	2																
2-6-0 *(d)*	1920	3	Wood	1.1	4.9	58	11.5	876	530	330	457	285	23.5	21 000	300	30	...	...	2																
2-8-0 *(d)*	1933	2	Wood	1.5	6	96	12	1 100	750	380	580	410	39.8	33 600	600	45	...	...	2																
Note. — Only locomotives used on secondary lines are mentioned in this table. We use more powerful locomotives (Santa Fe, Mikado, Pacific, Atlantic, Mallet) on our main lines, which although they are of 3′ 6″ gauge, cannot be considered as secondary lines owing to the heavy traffic they carry (Lourenço-Marquès to Transvaal frontier, and Mozambique line).																																			
RUMANIA. — State Railways.																																			
																												Small railcars.							
																				Sentinel Cammell 100 H.P.	millim. 17 830	tons (metr.) 31.955	55	11	...	...	...	2	both ends	1 driver 1 fireman	2 + 2 buffers	Westingh.	23.29	Yes	Only worked on secondary lines.
																												Twin railcars.							
																				Sentinel Cammell 200 H.P.	32 562	56.188	110	22	...	...	...	2	do.	do.	2 + 2 buffers	do.	39.15	Yes	do.
																												Note : Data taken from working results, financial year 1935.							
JUGOSLAVIA. — State Railways.																																			
				m^2	m^2	m^2	kgr./cm²	millim.	millim.	millim.	millim.	H.P.	tons (metr.)	tons (metr.)	tons (metr.)	km./h.	dinars	km.			millim.	tons (metr.)				m^2									
2-8-2	1933	13	Coal	1.25	5.03	39.47	14	1 220	875	355	460	330	36.6	20	210 at 60 km./h.	75	7.0	300	2	Ganz, Budapest	12 020	17.5	15 (II) 31 (III)	... ...	1	2	...	2	at both ends	1	Standard	compressed air and hand	..	Yes	Used on secondary lines. Can haul light carriage.
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	De Forenede Automobil-Fabriker, Odense.	11 552	17.5	20 (II) 30 (III) + 5 tip-up seats	...	...	...	...	2		1	Light standard		...	Yes	Used on main lines and secondary lines.
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Do.	21 420	53.5	30 (II) 38 (III) + 7 tip-up seats	...	1	4	...	2		1	Standard		...	Yes	do.

* Including all charges, i. e. with amortization charges and wages.

TABLE II. — Railcars or locotractors.

ITALY. — State Railways.

[illegible]

EGYPT. — State Railways.

[illegible]

SPAIN. — Northern Railway.

[illegible]

HUNGARY. — [illegible] Railways.

[illegible]

PORTUGAL (Colonies). — Lourenço-Marques Railways.

[illegible]

TABLE II. — Railcars or locotractors. *(continued).*

Types.	Year put into service.	Number in service.	Service: Passenger.	Goods.	Mixed: (passenger and goods).	Name of builder.	Length over buffers.	Weight, empty.	[illegible]: Seated.	Standing.	Goods compartment: Number.	Floor area.	Loading capacity.	[illegible] compartments: Number.	Location.	Driving staff.	Buffing gear.	Braking.	[illegible]	Number of cylinders	Horse-power of each engine	Number of engines	[illegible]	Number of speeds	Max. speed [illegible] the level.	[illegible]	[illegible]	[illegible]	Average daily [illegible]	Cost price [illegible]	[illegible] reversible?	REMARKS.
RUMANIA. — State Railways.																																
[illegible]	1934	9	Yes			Malaxa	13 000	[illegible]	(II) (III) 29 29	12	...	[illegible]	...	1	At one end	1 driver	2 + 2 buffers	Westingh.	Medows	6	120	[illegible]		[illegible]	[illegible]		[illegible]	...	241-202	20.34	...	No trailer hauled.
[illegible]	1934	15	yes			do.	10 8[illegible]	20 000 approx.	20 20	8				2	At both ends	do.	do.	Knorr	Vomag	6	120	1	[illegible]	[illegible]	[illegible]	...		[illegible]	241-202	20.51	[illegible]	Run as twin coa[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	...		do.	11 150 13 20[illegible]	22 000 approx.	20 35	11	...	...		2	...	do.	do.	Knorr	M.A.[illegible]	6	150/160	1	[illegible]	[illegible]	[illegible]			[illegible]	241-202	17.70	[illegible]	Hauls light trail[illegible] (11 000 kgr. an[illegible] Also run as twin [illegible]ches.
Ganz	1935	[illegible]	[illegible]			Malaxa Astra	10 700 11 100 13 800	20 000 [illegible]	20 25 17 42	9 12		...	...	2	[illegible]	do.	do.	Knorr Westingh.	Ganz	6	120 [illegible]		[illegible]	[illegible]	[illegible]		...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Westin[illegible]	190[illegible]	[illegible]	[illegible]		...	Schweitzer [illegible]	12 330 12 0[illegible] 12 080	17 600 16 400 12 085	12 24 17 25 17 25	7 8 8	...	...	...	1 1 1	At one end	do.	1 + 1 buffers	Westingh	...	...	90 70 60	[illegible]	[illegible]		[illegible]		...	[illegible]	[illegible]	[illegible]rtization	[illegible]	Hauls 45-seat trai[illegible] [illegible]ler hauled. Not run as twins.
SWITZERLAND. — Federal Railways.																																
[illegible]	[illegible]	2	[illegible]		...	Schweiz. [illegible] Fabrik. [illegible]nterthur	22 310 (overall)	34 000	[illegible] 65		2 (optional)	2.5	1 000	2	Both ends	1	...	Air	Sulzer Br. Winterthur	6	290	1	[illegible] S.L.M.	5	[illegible]			[illegible]	[illegible]	No data	[illegible]	See drawing.
CZECHOSLOVAKIA. — State Railways.									Seated + standing.																							
[illegible]	[illegible]	[illegible]	[illegible]		..	[illegible] Verke	13 600	20 000	65		..		...	2	1 at each end	1 driver	Standard		Tatra	6	100	1	Mechan	[illegible]	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]			.	Severoceska	18 270	34 900	83		..		..	2	do.	do.	»		D.W.K	6	150	1	do.	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]			..	Tatra	18 850	34 000	68				...	2	do	do.	»		Tatra	6	75	2	do	4	[illegible]							
[illegible]	[illegible]	[illegible]				Tatra	18 900	34 200	68				..	2	do.	do.	»		[illegible]	6	100	2	do	[illegible]	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]				Tatra	21 000	38 800	82			..	.	2	do.	do.	»		[illegible]	6	100	2	do.	4	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]			.	Brno-Krá[illegible]	19 850	40 760	75			..	.	2	do	do.	»		B.K.P	6	100	2	Electric.		[illegible]							
[illegible]	[illegible]	[illegible]				Tatra	21 000	39 780	65		.	.	...	2	do	do.	»		Tatra	6	100	2	Mechan.	4	[illegible]							
[illegible]	[illegible]	[illegible]				Brno-Krá[illegible]	19 850	43 900	75		.		..	2	do.	do.	»		B.K.P	6	120	2	[illegible]		[illegible]							
[illegible]	[illegible]	[illegible]				Tatra	18 850	34 000	74		.		...	2	do.	do.	»		Tatra	6	125	2	Mechan.	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]				Tatra	21 000	43 000	68		.	.	...	2	do.	do.	»		[illegible]	6	100	2	[illegible]		[illegible]							
[illegible]	[illegible]	[illegible]				Skoda	18 300	50 160	54				..	2	do.	do.	»		Skoda	6	300	1	[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]				Tatra	21 000	39 100	68				..	2	do.	do.	»		Tatra	6	100	2	Mechan	4	[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]			Tatra	21 000	40 000	68		.		..	2	do.	do.	»		[illegible]	6	100	2	do	4	[illegible]							
[illegible]	[illegible]	[illegible]				Brno-Královopolská	19 980	44 500	81				...	2	do.	do.	»		B.K.P.	8	160	2	Electric		[illegible]							
[illegible]	[illegible]	[illegible]				Moravsko-Slezská	11 800	18 800	48		.		...	2	do.	do.	»		Tatra	6	100	1	do		[illegible]							
[illegible]	[illegible]	[illegible]		...		[illegible]	do	do	48			.	..	2	do.	do.	»		[illegible]	6	100	1	do		[illegible]							
[illegible]	[illegible]				.	[illegible]	do.	do.	48		...		..	2	do.	do.	»		[illegible]	6	100	1	do.		[illegible]							
[illegible]	[illegible]				..	[illegible]	do.	15 900	58		...		..	2	do.	do.	»		Gräft	6	100	1	do		[illegible]							
[illegible]	[illegible]					[illegible]	do.	16 620	48		..		...	2	do	do.	»		[illegible]	6	100	1	do		[illegible]							
[illegible]	[illegible]					[illegible]	do.	[illegible]	48		..	.	...	2	do.	do.	»		[illegible]	6	100	1	do		[illegible]							
[illegible]	[illegible]		[illegible]		.	[illegible]	12 000	19 800	48		...	.	...	2	do.	do.	»		[illegible]	6	100	1	do		[illegible]							
do.	1929	2	[illegible]	.	..	[illegible]	do.	do.	48		..		...	2	do.	do.	»		[illegible]	6	100	1	do		[illegible]							
[illegible]	[illegible]	2	[illegible]	...	.	[illegible]	do.	do	48		...	...	..	2	do.	do.	»		[illegible]	6	100	1	do		[illegible]							
Diesel	1932	2	[illegible]		...	Skoda	12 000	19 770	50		...	...	...	2	do.	do.	»		Skoda	6	100	1	do		[illegible]						[illegible]	
do	[illegible]	5	[illegible]			»	do.	20 080	48		...	...	...	2	do.	do.	»		[illegible]	6	100	1	do		[illegible]				Distance [illegible] daily : 180 km.	Average cost price 3.21 Kc. per km.	[illegible]	
Petrol	[illegible]	[illegible]	[illegible]	.		[illegible]	10 300	16 300	38		...	...	...	2	do.	do.	»	Compressed air	[illegible]	6	78	1	do		[illegible]						[illegible]	
Diesel	[illegible]	11	[illegible]	.		[illegible]	12 000	17 550	52		...	..	...	2	do.	do.	»		[illegible]	8	120	1	do		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	do	18 060	52		...	...	...	2	do.	do.	»		[illegible]	8	120	1	do		[illegible]						[illegible]	
[illegible]	[illegible]	2	[illegible]			[illegible]	do.	19 190	52		...	..	..	2	do.	do.	»		[illegible]	8	160	1	do		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]		..	Moravsko-Slezská	11 800	17 700	48		...	..	...	2	do.	do.	»		Tatra	6	125	1	do		[illegible]						[illegible]	
[illegible]	1935	5		..		»	13 200	19 510	58			...	...	2	do.	do.	»		[illegible]	6	125	1	do.		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]				[illegible]	do.	22 700	58		...	...	...	2	do.	do.	»		[illegible]	6	125	1	do		[illegible]						[illegible]	
[illegible]	1933	6		[illegible]		[illegible]	11 800	17 400	48		...	...	.	2	do.	do.	»		[illegible]	6	120	1	do		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]				[illegible]	do.	do.	48		...	...	...	2	do.	do.	»		[illegible]	6	120	1	do		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]				Cesko-moravská	11 800	19 450	48		..	.	...	2	do.	do.			C.K.D.	6	130	1	do.		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	do	do.	48		...	..	...	2	do.	do.	»		[illegible]	8	130	1	do.		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	..	...	[illegible]	13 200	19 800	58		...	..	...	2	do.	do.	»		[illegible]	8	150	1	do.		[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]		...	Severoceska	11 870	28 680	44		...	..	..	2	do.	do.	»		Man	6	150	1	do.	...	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]			Tatra	8 060	7 200	32		...	...	...	1	central	do.	Central		Tatra	6	65	1	Mechan.	4	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]		.	Cesko-moravská	8 210	7 000	29		...	..	...	1	at 1 end	do.	do.		C.K.D.	4	55	1	do	4	[illegible]						No	Cannot haul a trailer.
[illegible]		1	[illegible]			Skoda	8 820	8 850	29		...	...	...	1	do.	do.	do.		Skoda	4	56	1	do.	4	55						[illegible]	
[illegible]	1928	10	[illegible]			[illegible]	do	7 880	29		...	...	...	1	do.	do.	do.		[illegible]	4	56	1	do	4	[illegible]						[illegible]	
[illegible]	[illegible]	26	[illegible]			Tatra	9 300	7 600	32		...	...	...	2	at both ends	do.	Central		Tatra	6	65	1	do	4	54						Yes	
[illegible]	[illegible]	26				[illegible]	»	8 300	36		...	..	..	1	central	do.	»		[illegible]	6	65	1	do.	4	[illegible]						[illegible]	
[illegible]	1930	69				[illegible]	10 530	12 500	37		..	..	...	1	do.	do.	Standard		»	6	100	1	do	4	[illegible]						[illegible]	
[illegible]	1933	10				[illegible]	»	do.	37		...	..		1	do.	do.	»		»	6	115	1	do	4	45						[illegible]	
[illegible]	[illegible]	[illegible]					10 700	12 870	36		...	...	..	1	do.	do.	»		[illegible]	6	120	1	do	4	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]					9 200	7 300	30		...	.	...	1	do.	do.	»		[illegible]	6	65	1	do	4	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]				Skoda	10 650	13 100	38		...	...	...	2	at both ends	do.	»		Skoda	6	100	1	do	4	[illegible]						[illegible]	
[illegible]	[illegible]	27					do.	13 600	38		...	.	...	2	do.	do.	»		»	6	120	1	do.	4	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]					do.	do.	38		...		...	2	do.	do.	»		[illegible]	6	120	1	do	4	[illegible]						[illegible]	
[illegible]	[illegible]	50				Tatra	10 530	12 500	37		...		...	1	central	do.	»		Tatra	6	115	1	do	4	[illegible]						[illegible]	
[illegible]	[illegible]	12				[illegible]	10 610	do.	37		...		...	1	do.	do.	»		[illegible]	6	115	1	do	4	[illegible]						[illegible]	
[illegible]	1936	10					do.	[illegible]	37		...		..	1	do.	do.	»		[illegible]	6	115	1	do	4	[illegible]						[illegible]	
[illegible]	1934	10					do.	12 620	37		..		..	1	do.	do.	»		[illegible]	6	120	1	do	4	[illegible]						[illegible]	
JUGOSLAVIA. — State Railways.									Seated + standing																							
[illegible]	1928	2	yes		...	Ganz-Budapest	12 020	17 500	15 (II) 31 (III)		1	2	...	2	At both ends	1	Standard	Compressed air and hand brakes	Ganz	6	90	1	Pneumo-mechan.	4	[illegible]	..	[illegible]	Yes	188		Yes	The railcars are used on secondary lines, can haul a light passenger coach and be run as twin-coaches.
Diesel	1936	3	Yes	..	...	De Forenede Automobil fabriker. Odense	11 552	17 500	20 (II) 30 (III) + 5 tip-up seats		...	..	...	2	do.	1	Light standard		Hesselman	6	75	1	Pneumo-mechan. [illegible] (Voith)	4	70	..	...	Yes	[illegible]	..	Yes	Used on main- and secondary lines. Cannot be run as twin-coaches.
Diesel	do.	do.	do.	...	...	do.	21 420	53 500	30 (II) 38 (III) + 7 tip-up seats		1	1	...	2	do.	1	Standard		Burmeister & Wain	6	280	1	Electric		70	...	...	Yes	248	...	Yes	Used on main- and secondary lines. Cannot be run as twin-coaches.

Including all charges, i. e. with amortization charges and wages.

SWITZERLAND. — Federal Railways.

a) We have not altered the rolling stock, but trains on these lines have no 1st-class coaches.

b) No reply.

c) No.

d) On these lines we prefer to use light rolling stock of old design.

CZECHOSLOVAKIA. — State Railways.

a) No.

JUGOSLAVIA. — State Railways.

We have done away with 1st-class and we use for these trains the lightest coaches we have of the current type, bearing in mind the maximum axle load allowed on these lines.

QUESTION 8. — a) *Do you couple trailers (passenger or goods) to railcars?*

b) *If so, how many and what are their characteristics?*

c) *Is there any intercommunication between railcars and trailing passenger coaches?*

REPLIES.

ITALY. — State Railways.

a) Not at present.

We are now trying out self-propelled triplet trains, but these are intended to run at speed on our main lines.

ITALY. — Piedmontese Tramways Co.

a) Yes. The total weight of a train must not exceed 70 tons.

AUSTRIA. — Federal Railways.

a) We do not as a rule couple vehicles of the current type to railcars, in view of the fact that railcars are not very strongly built. When the need arises, we attach to railcars vehicles of a light type or else of special design and which are in communication with the railcar by a gangway.

Only railcars of the very latest type, which are strongly built, can haul vehicles of the ordinary type.

Electric motor coaches on electrified lines are considered, according to the type of construction, as light engines.

EGYPT. — State Railways.

a) No.

SPAIN. — Northern Railways.

We have railcars which can haul one passenger coach. The trailer has no means of access to the railcar.

The characteristics of the trailer are as follows :

Number of wheels	4
Distance between buffers .	6.24 m. (19′ 7″)
Weight empty	4 tons
Number of seats in 3rd class	40

The trailers are fitted with Westinghouse continuous brakes. The vacuum in the brake pipe is produced by the petrol engine of the railcar.

HUNGARY. — Royal State Railways.

As a rule railcars can haul 2 or 3 very light trailers (12 tons) of the categories BCx, DFx, Fgx. Intercommunication between the railcar and the trailers is provided.

PORTUGAL. — Portuguese Railways Co.

We have no railcars in service.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

a) Yes; Michelin type.

c) No.

RUMANIA. — State Railways.

We only have trailers on passenger services : 53 trailers, of which 20 of special design, and 33 converted « C » coaches.

SWITZERLAND. — Federal Railways.

No.

CZECHOSLOVAKIA. — State Railways.

a) Yes. 2 to 3 specially designed

trailers, remarkable for their light weight, are hauled by railcars. These trailers are fitted with communication gangways for the train staff.

As regards goods wagons, see reply to *question 10*.

JUGOSLAVIA. — State Railways.

a) We couple trailers to diesel-electric railcars of the heavy type.

The coaches trailed, two at most, are 3rd-class, 4-wheeled; wheel base 9.30 m. (30′ 6″); length over buffers 15.43 m. (50′ 7 1/2″); tare 21 tons; 70 seats.

There is a gangway between the trailers but none between railcar and trailer, the motor car having a driver's cabin at each end.

QUESTION 9. — *Do you impose any speed limit on railcars hauling one or more trailers?*

REPLIES.

The replies received show that as a rule no speed limit is imposed on railcars hauling one or several trailers.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

The speed limits indicated by the Michelin firm.

RUMANIA. — State Railways.

No.

SWITZERLAND. — Federal Railways.

See question No. 8.

CZECHOSLOVAKIA. — State Railways.

The speed of railcars hauling trailers is only limited by the power of their engines.

JUGOSLAVIA. — State Railways.

No, but the speed under such conditions is naturally lowered owing to the increased load.

QUESTION 10. — a) *On secondary lines do you work all traffic (passenger and goods) by means of railcars?*

b) *If so, state all the chief characteristics of the district served (agricultural, industrial, etc.) and of the traffic handled.*

c) *What opinion have you formed, in view of results gained from experience, as to the advisability of using this method of working in the various instances that may arise, taking into account the importance and variety (peaks) of the traffic to be handled?*

d) *If there is only little goods traffic in full wagon loads to handle, is it possible to have wagons hauled by railcars without inconvenience*?

REPLIES.

ITALY. — State Railways.

Only on the Rocchetta-Spinazzola line is the passenger traffic and goods traffic (motor-vans) entirely worked by railcars. On all other lines goods traffic is carried in steam trains.

We believe that motor-vans will eventually be capable of entirely replacing goods trains on many other lines.

ITALY. — Piedmontese Tramways Co.

a) Yes.

b) Agricultural district : traffic handled annually : passengers, 1 000 000; goods, 120 000 tons.

c) Yes.

AUSTRIA. — Federal Railways.

a) No.

EGYPT. — State Railways.

a) Passenger and fast goods traffic on certain lines. No ordinary goods service.

c) Experience has taught us that the use of steam railcars and diesel railcars has given good results on secondary lines.

d) No.

SPAIN. — Northern Railways.

We have no secondary lines on which the service (passenger and goods) is carried out solely by railcars, owing to the nature of the traffic, which is mostly agricultural and bulky.

We think that on lines carrying very light traffic, the entire passenger and goods service might usefully be carried out by railcars, and if we have not altered our policy accordingly, this must be attributed to the fact that railcar services were only started very recently, and to the difficulties we have to overcome in adapting our working methods to the new equipment.

HUNGARY. — Royal State Railways.

a) No.

d) In case of need and if the loading regulations allow it, it sometimes happens that one or two goods wagons are hauled by a railcar.

PORTUGAL. — Portuguese Railways Co.

No reply.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

a) No, it is not possible, with the railcars in service, to maintain a frequent service. At traffic peak times we replace the railcars by steam trains.

d) No.

RUMANIA. — State Railways.

a) No, only for passengers.

SWITZERLAND. — Federal Railways.

a) No, not the whole of the traffic.

CZECHOSLOVAKIA. — State Railways.

See *question 5.*

The number of lines of the Czechoslovak State Railways on which *all passenger traffic* was carried in motor trains, was 29 in 1935. These are local railways of a total length of 557 km. (346 miles) and they run through districts that are not highly developed in-

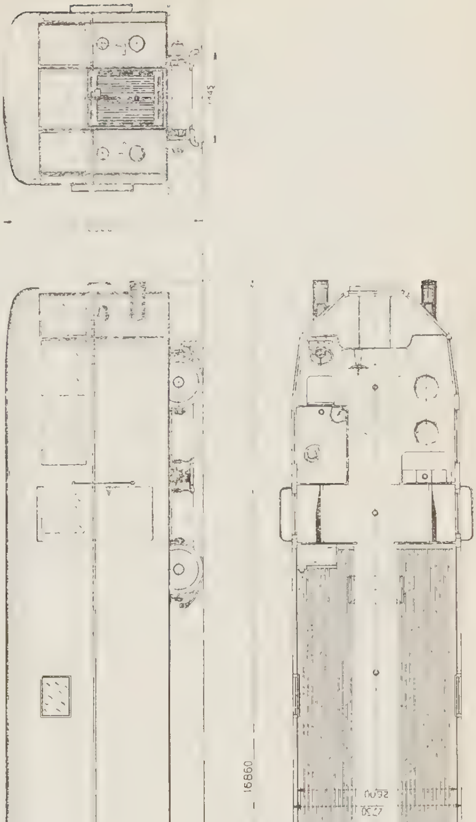


Fig. 5. — Diesel motor van, Italian State Railways.
Maximum load, 8 tons. — Capacity 44 m³ (1 554 cu. ft.)

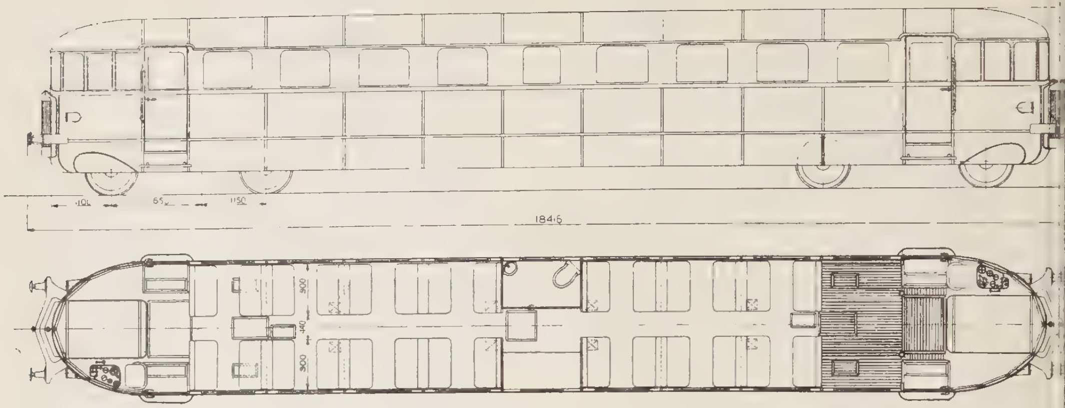


Fig. 6. — 56-seat petrol railcar, Italian State Railways.

dustrially. As regards the number of lines on which *all passenger and goods traffic* is carried by motor trains, in 1935 the State Railways owned 16. These are local lines having a total length of 190.9 km. (118.6 miles) running through poor districts without any commerce or industry. On these lines railcars haul ordinary goods wagons : 1 to 3, according to traction circumstances.

JUGOSLAVIA. — State Railways.

We carry no goods traffic in railcars on any of our lines, only part of the passenger traffic.

The introduction of railcars is quite recent, and we have had no experience which would enable us to reply to the other points of the question set.

QUESTION 11. — *What are the various advantages you have gained from using railcars on secondary lines?*

a) *Development or recovery of traffic as a result of the :*

— *increased number of runs owing to a reduced cost price per railcar-kilometre (or mile);*

— *increased average speed;*

— *increased number of stops so as to better serve localities situated along the line, etc.*

b) *Saving in working expenses, etc.*

REPLIES.

ITALY. — State Railways.

The advantages gained from the use of railcars are :

a) From the working point of view : increased train frequency, consequently a more satisfactory service to the public; increase of the average train speed.

b) From the economic point of view : less expensive working; regaining of traffic that had left the railway and, in certain cases, an actual gain in the number of passengers carried.

The public has shown a very lively appreciation of railcar services on account of their speed and frequency, and we can safely state that on secondary lines they have considerably improved matters.

As a rule, we have not increased the number of stops.

ITALY. — Piedmontese Tramways Co.

The advantages gained are as follows :

a) Increase in the number of runs.

b) Increase average train speed.

c) The necessity for increasing the number of stops has not been felt, in general.

d) Economy in working expenses : lower traction costs.

AUSTRIA. — Federal Railways.

The constant falling-off of passenger traffic does not enable us to give any definite reply. However, each time that traffic formerly carried in steam trains has been replaced by a larger number of railcar trips (less expensive), we were found an appreciable increase in passenger traffic without any increase in expenses.

Owing to the greater number of runs and to indiscriminate use of rolling stock, either on main or secondary lines, we cannot make any statement as to savings made in working expenses.

EGYPT. — State Railways.

From the point of view of cheap working, railcars have given satisfactory results, as it has been possible to increase train frequency and consequently to meet competition from road traction.

Furthermore, owing to the very rapid acceleration of railcars, the introduction of more intermediate stops was much facilitated.

SPAIN. — Northern Railways.

We have been able to ascertain the following advantages : greater flexibility of the service. We have increased the number of runs as a result of the lower cost price per train-km.

We have also been able to increase the average speed and the number of stops (with the faculty of also making stops on the open line), to give a better service to the public living close to the railways, and at the same time effect savings in working expenses.

HUNGARY. — Royal State Railways.

We have been able to obtain :

a) Increased train frequency and speed.

b) Lower working expenses.

PORTUGAL. — Portuguese Railways Co.

No reply.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

By the use of railcars we have obtained greater flexibility in meeting the demands of the public and a considerable reduction of expenses.

Our railcar service only started recently but for a year past we have noticed that owing to the use of Michelin railcars our expenses per kilometre run and per passenger carried are almost the same as what they were when the service was carried out by steam trains, but that receipts have gone up by 40 %. One may state that traffic has been regained because the price for tickets is the same by railcar as by steam train.

In effect, railcars compete very much with motor buses running on the roads alongside our lines. In certain cases we have doubled the number of our runs; the average speed has increased from 36 km. an hour to 47 km. (22.4 to 29.2 miles).

RUMANIA. — State Railways.

a) 40 % of the steam trains have been replaced by railcars, which enabled us to increase the train mileage by 36.6 %, the cost of a railcar-km. being one third that of the steam-train-km.

The average speed has increased 21.3 %.

b) By the introduction of railcars we obtained, in 1935, the following results :

— the working of railcars caused no deficit;

— receipts from steam train operation in the same period and on the same lines only covered 60 % of the working expenses.

SWITZERLAND. — Federal Railways.

Railcars were introduced to improve the normal time tables. The result has been an increase in passenger traffic.

CZECHOSLOVAKIA. — State Railways.

From the standpoint of train service, motor traction has the following advantages as compared to steam traction :

1. railcars are immediately ready for service (less preparatory work than in the case of a steam locomotive);

2. they are light and run easily, hence a reduction in the time spent on trips and possibility of increasing the number of stops;

3. motor traction is less expensive than steam traction (only one man required, and cheaper fuel), which enables us to increase the number of trains, viz. intensify and accelerate transportation in small units;

4. owing to the low axle load, passengers arriving from a main line can continue their journey without changing trains on reaching a local line, or vice versa.

JUGOSLAVIA. — State Railways.

The number of runs and the average speed have been increased in certain cases.

From the working standpoint, the advantages are as follows : increased average speed and less shunting at terminal stations in the case of railcars not hauling trailers.

QUESTION 12. — *What are the drawbacks (difficulty of coping with traffic peaks, large reserve rolling stock required, etc.) you have met with in using railcars on secondary lines?*

REPLIES.

ITALY. — State Railways.

We have not found any drawbacks when, during certain periods of the day or of the week, we had to transport an exceptional number of passengers, as we made use of our reserve of railcars in such cases.

We usually have 1 railcar in reserve for each 7 or 8 in service.

However, serious difficulties are met with when there is a rush of passengers at places where no spare railcars are available.

ITALY. — Piedmontese Tramways Co.

No difficulties have been encountered.

AUSTRIA. — Federal Railways.

Seeing that on lines carrying only light traffic our railcars have hitherto not been able to haul ordinary vehicles, fully loaded wagons and parcels wagons have had to be hauled by steam locomotives.

The running of steam trains instead of railcars has also been necessary in special instances, e.g. an extraordinary rush of passengers, very low temperature and consequent difficulty of heating the railcars, etc. However, these difficulties will disappear as soon as new railcars of the latest type are put into service.

EGYPT. — State Railways.

No reply.

SPAIN. — Northern Railways.

The principal drawbacks are the following :

Difficulty of ensuring the availability of the requisite reserve rolling stock.

Another drawback met with when using railcars is that when any serious damage occurs it is necessary to replace the whole train, which means — when that happens on the open line — unpleasantness and considerable delays.

Railcar services do not have the requisite flexibility when there is a rush of passengers.

HUNGARY. — Royal State Railways.

The goods traffic (complete wagon loads and small consignments) is worked once a day in each direction by a steam hauled train. Only in exceptional cases is a goods wagon hauled by a railcar.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

As we are still in the trial stage we have no railcars in reserve. When a railcar is not available we replace it by a steam train.

RUMANIA. — State Railways.

The lines worked by railcars are grouped by centres. In each centre there are reserve vehicles; no drawbacks were found in this respect.

SWITZERLAND. — Federal Railways.

The introduction of railcars on secondary lines only took place on 1st January 1936; our experience in this field is too short for a definite opinion being voiced.

CZECHOSLOVAKIA. — State Railways.

The drawbacks of motor traction as compared to steam traction are as follows :

1. restricted power of railcars (which is a drawback when there is a large number of passengers to be carried);
2. frequent breakdowns of railcars, in consequence of which it is frequently necessary to replace motor trains by steam trains (traffic delays);
3. motor vehicles are usually less comfortable than steam trains (special compartments, heating, etc.).

JUGOSLAVIA. — State Railways.

We have not found any difficulties in coping with passenger traffic peaks, especially on suburban lines.

III. — Safety measures applied.

QUESTION 13. — *Are all level crossings on secondary lines guarded?*

Explain the various regimes to which level crossings are submitted.

In the case of unguarded level crossings, state how road users are warned of the approach of trains (audible or optical signals carried on trains, road signs : winking lights, etc.). Has visibility at level crossings been improved?

REPLIES.

ITALY. — State Railways.

All level-crossings are guarded or closed when a train approaches.

ITALY. — Piedmontese Tramways Co.

The level crossings are not all guarded : road users are warned at unguarded level crossings of the approach of trains by means of audible signals.

AUSTRIA. — Federal Railways.

As a rule, on our local railways level crossings are not fitted with barriers, unless decided otherwise, according to local circumstances, by the Supervising Authority. The same Authority decides as to the type of signals to be fitted for warning road users.

EGYPT. — State Railways.

Our level crossings are not all guarded. The more important ones are fitted with gates, and are either guarded day and night or only guarded by day.

Warning is given to road users only by sign boards on either side of the road.

SPAIN. — Northern Railways.

(See figs. 7 and 8.)

The level crossings on our secondary lines are not all guarded. According to regulations laid down by the Public Authority in this respect they are subject to various rules.

They are, however, classed into 4 categories : *a*), *b*), *c*), *d*), according to the importance of the roads crossing our lines and the amount of traffic on them.

In certain cases gatekeepers may be dispensed with at crossings of category *a*) if the following signals are installed there : winkling lights, distant signals, and interlocked barriers worked from a distance by the railway staff.

Gatekeepers may be eliminated at category *b*) crossings when automatic colour light signals actuated by track circuits are fitted, and when warning signs are placed on the roads.

Level crossings of category *c*) are subjected to the same rules if there are road signs and if the following visibility conditions are complied with :

At 15 m. (17 yards) from the nearest rail, on the centre line of the road, the railway must be visible, from both sides of the road for 600 m. (660 yards) if the maximum speed on the railway is under 70 km. (43.5 miles) an hour or 800 m. (880 yards) if the train speed is 70 km. or over.

At level crossings of category *c*) where such visibility does not exist, guarding may be dispensed with if automatic and distant signals as prescribed for category *b*) are installed.

Crossings of category *d*) may be left unguarded provided that an ordinary fixed signal, unlighted, on the road, and a « whistle » signboard on either side of the railway and at 600 m. (660 yards) from the crossing are installed.

If at certain periods of the year road traffic should increase considerably, the Company is bound to temporarily restore the gate-keepers if the visibility conditions as mentioned above for category *c*) are not fulfilled.

As a consequence of the above official dispositions the Company adopted the following regulations :

1. All level crossings classed in categories *a*) and *b*) are guarded;
2. Installation of barriers, in general, at all level crossings situated near stations, such barriers being worked and interlocked from a distance by station employees.
3. Suppression of gate-keepers at all level crossings classed in category *c*), which fulfil the above mentioned conditions as regards visibility, gate-keepers being retained at those which do not meet the said conditions;
4. Suppression of gate-keepers at nearly all level crossings classed under category *d*) except in cases where, there is heavy traffic and insufficient visibility.

HUNGARY. — Royal State Railways.

As a rule, level crossings are not guarded nor are there any barriers, except where there is heavy road traffic, in which case the Government order barriers to be fitted.

At level crossings without barriers there are road signs bearing the notice : « Beware of trains ».

If engine drivers approaching a level crossing have no good visibility 150 m. (165 yards) on both sides of the road, warning signals are placed on the railway at 150 m. from the crossing, requesting the engine driver to whistle. The head-light of trains serves at night to warn road users.

No winking-lights or automatic signals are used at unguarded level crossings.

Visibility conditions at crossings are constantly being improved, and every precaution is taken in this respect; trees and bushes which impede good visibility are cut down.

PORTUGAL. — Portuguese Railways Co.

Level crossings are not all guarded. Our organisation is as follows :

1. Crossings at which there is much traffic either during the daytime or at night : barriers are normally open, but are closed when trains pass;
2. Crossings at which traffic is lighter than at the former, or where traffic is intermittent : barriers, open during the day, are closed when trains pass; at night barriers are only opened to let road vehicles through;
3. Crossings at which traffic is medium : barriers are normally closed day and night, but are opened to let vehicles through;
4. Crossings on lines where there are very few trains : barriers are normally open, but are closed when trains pass;
5. Crossings where there is very little

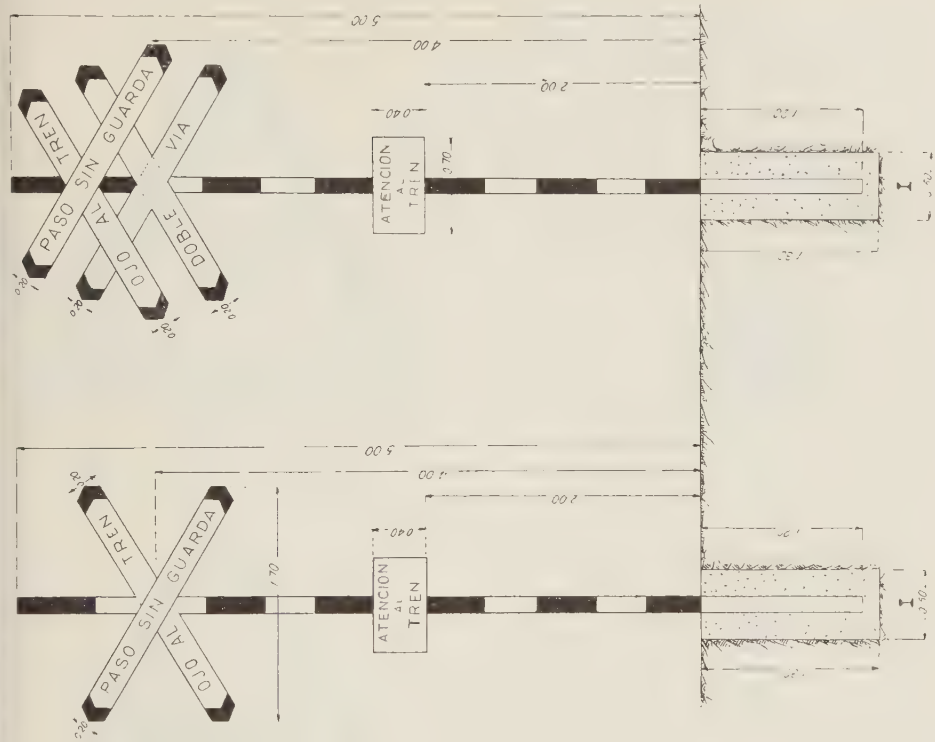


Fig. 8. — Type A sign post, Northern Railways, Spain.

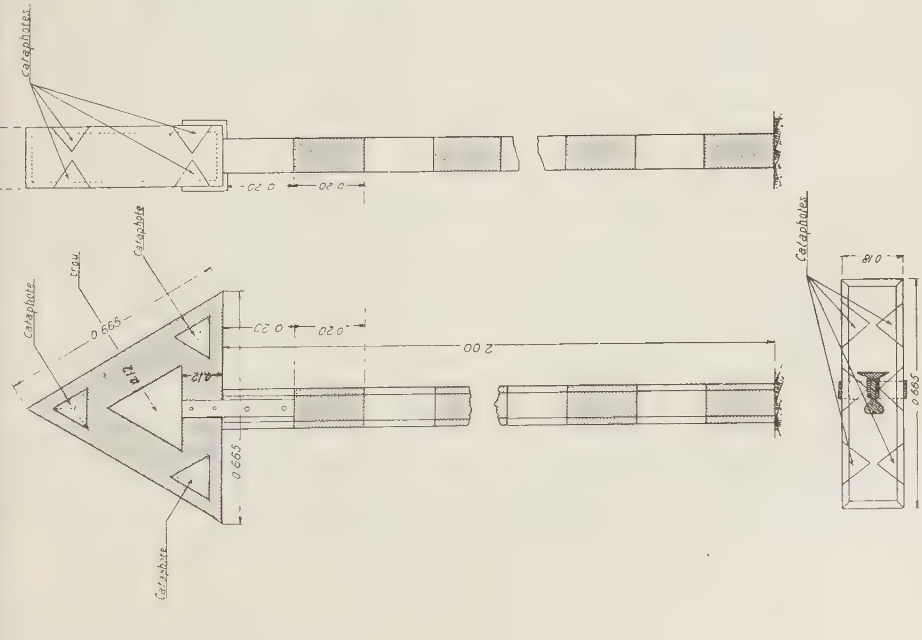


Fig. 7. — « Stop » indicator post, for railcars, Northern Railways, Spain.

traffic : neither gate-keepers nor barriers.

There is no appliance to warn people of the approach of trains, as visibility is usually sufficient.

A law is about to be promulgated ordaining the signalling of such crossings.

Visibility has not been improved.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Level crossings are guarded only if they are situated near towns where automobile traffic is intense.

Road users are warned of the approach of trains by audible signals placed near level crossings.

Visibility near level crossings has been improved by cutting down trees and bushes that might impede it.

RUMANIA. — State Railways.

Only the more important level crossings are guarded, whereas the less important ones have St. Andrew's cross signs placed at them.

On approaching level crossings drivers have to whistle.

Visibility at level crossings has been improved.

SWITZERLAND. — Federal Railways.

Our level crossings are not all guarded. In this respect, they are classed as follows :

a) Crossings with barriers worked by gate-keepers on the spot.

b) Crossings with barriers worked from a distance.

c) Crossings protected by fixed automatic optical and audible signals.

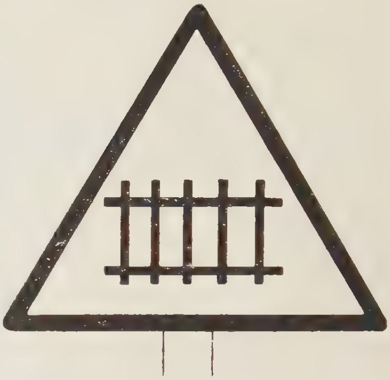
d) Crossings with fixed warning signboards or posts.

See figures 9 to 14.

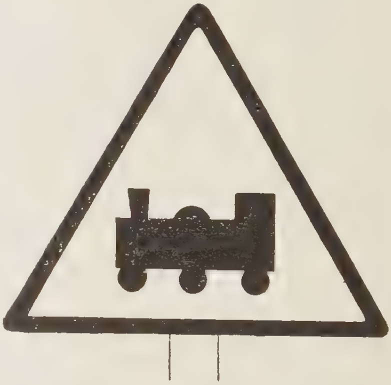
CZECHOSLOVAKIA. — State Railways.

Level crossings on secondary lines are not as a rule guarded, safe in exceptional cases marked out by the supervising authorities. On unguarded level crossings there are placed on the left hand side of roads, in each direction, warning signals in the form of crosses and when visibility is insufficient there are also distant signals. If the level crossing does not give a sufficiently clear view of the railway, viz. if the distance on which there is a clear view is not in proportion to the speed allowed, trains have to signal their approach by repeated whistling when they reach the warning sign post.

Fig. 9.



Approach signboard for guarded level crossings, Swiss Federal Rys.



Approach signboard for unguarded level crossings, Swiss Federal Rys.

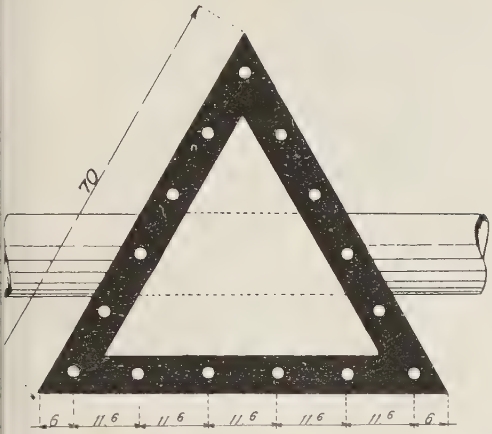


Fig. 10. — Triangular signboard for barriers (Type with cat's eye reflectors). Swiss Federal Rys.

JUGOSLAVIA. — State Railways.

Level crossings on secondary lines are unguarded but those where there is much road traffic are either protected by mechanical means or by gate-keepers.

Near all our level crossings, and at a distance, signboards draw the attention of drivers to the nearness of the railway. At some level crossings audible signals are installed. Visibility at level crossings is sufficiently good.

Special signals are placed on the line to warn drivers that they are approaching a level crossing.

QUESTION 14. — *On your secondary lines have you level-crossing barriers that are worked automatically? If so, describe the system briefly.*

No case reported by any of the Administrations who replied to the questionnaire.

QUESTION 15. — a) *Have you any double-tracked secondary lines?*

b) *Have you substituted on your secondary lines a simplified signalling for the normal signalling as used on main lines?*

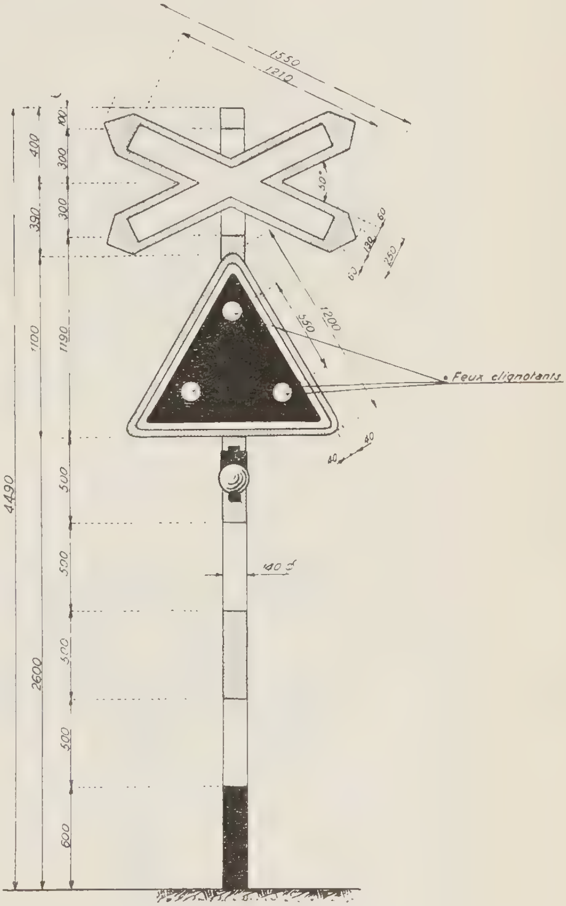


Fig. 11. — Winking-light signals replacing barriers at level crossings on roads carrying heavy motor traffic, Swiss Federal Rys.

c) *If so, do you use signals for the protection of stations, to ensure the correct headway between trains, and on* single-track lines, *for the crossing and overtaking of trains?*

d) *If you use signals of a special type, give a description of them with particulars as to their location.*

REPLIES.

ITALY. — State Railways.

a) No.

b) No; on secondary lines we have as a rule stop signals not preceded by distant signals, and which protect a train that has come to a standstill. On some lines, instead of signals we have posts indicating the entry to stations.

ITALY. — Piedmontese Tramways Co.

No.

AUSTRIA. — Federal Railways.

a) No. As regards facilities granted for signalling, see reply to *question 2*.

We have no special type of signals for secondary lines.

EGYPT. — State Railways.

a) No.

b) Our signalling system is the same on all our lines.

The block and lock system is in use at places where a saving may be effected thereby.

SPAIN. — Northern Railways.

a) and *b*) We have no double-track secondary lines, nor have we introduced simplifications nor modifications to the standard signalling which we use on our other lines.

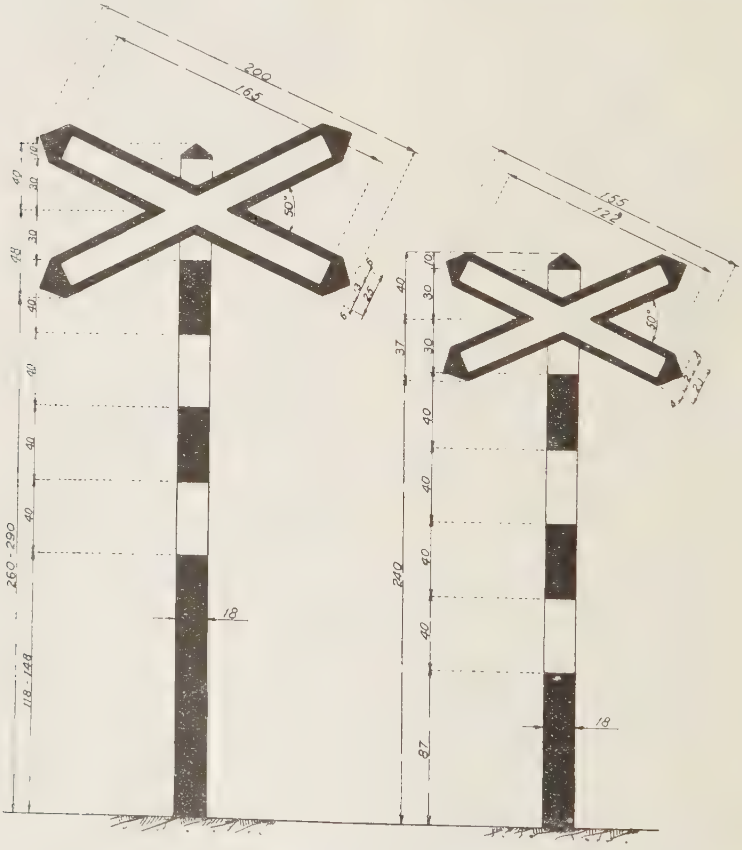


Fig. 12. — Warning sign posts for unguarded level crossings on carriage roads and lanes, Swiss Federal Railways.

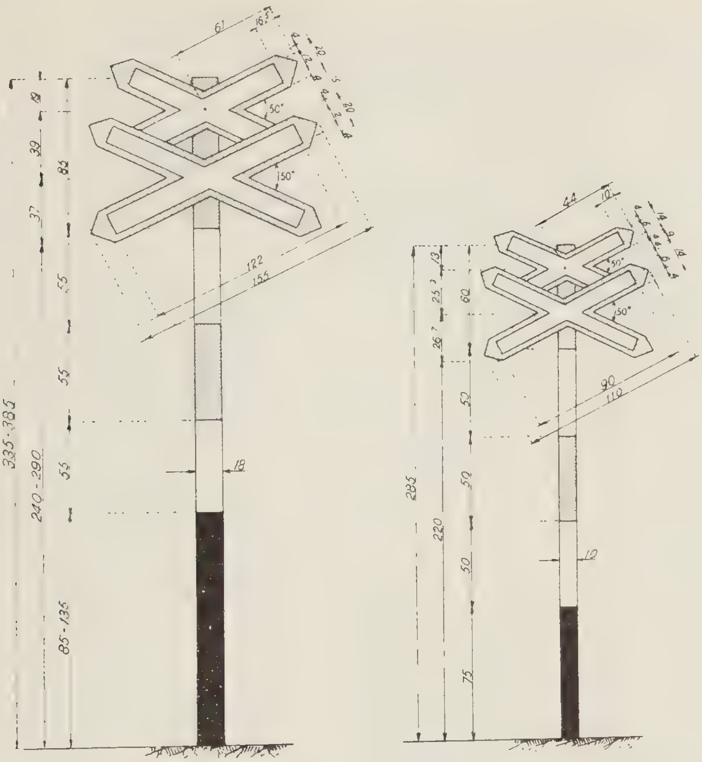


Fig. 13. — Sign for unguarded level crossing on double- or multiple-track lines, Swiss Federal Rys.

We have only adopted special signalling as the result of new services started, in places where we have authorised drivers to stop trains for taking or dropping passengers on the open track. (See fig. 7.)

HUNGARY. — Royal State Railways.

a) There are none.

b) The same system of signalling as on our main lines.

PORTUGAL. — Portuguese Railways Co.

a) and *b*) No.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

a) No.

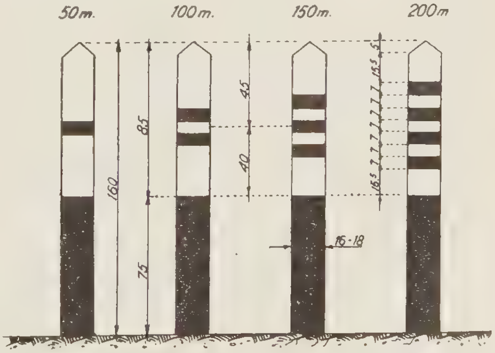


Fig. 14. — Indicator posts showing the distances between the distant signal and the main signal of the level crossings, Swiss Federal Rys.

b) Our lines cannot be likened to secondary lines in Europe. A line which carries annually a million and a half tons of traffic cannot be classed as a secondary line.

On such a line we now install automatic electric signalling with home signals, distant signals and permissive signals with electro-magnetic point working. Trains enter stations at a speed of 10 km. (6 miles) an hour.

RUMANIA. — State Railways.

a) No.

b) On secondary lines we use the same signalling as on main lines.

SWITZERLAND. — Federal Railways.

a) No.

b) Standard signalling.

CZECHOSLOVAKIA. — State Railways.

a) We have no double-track secondary lines. On secondary lines on which the movement of trains in both directions is controlled by a single employee from a given station on the line (the other stations not being staffed by traffic officials) signals are not as a rule installed.

On secondary lines having a more heavy traffic, and the stations of which are also staffed by traffic officials, we have home signals and distant signals identical to those used on the main lines.

We have no special signals for secondary lines.

JUGOSLAVIA. — State Railways.

a) We have no double-track secondary lines.

On our secondary lines we have no semaphores, but only signals of a special type.

QUESTION 16. — *When you have suppressed signals protecting stations or replaced signals of the normal type by simple marker posts, what are the speed limits imposed on trains entering stations, particularly when crossing another train?*

REPLIES.

ITALY. — State Railways.

In stations where we have replaced signals by marker posts, trains must, in case of crossing, stop in front of the indicator and then only advance after authorisation has been given by the responsible employee.

ITALY. — Piedmontese Tramways Co.

Trains must in all cases only enter stations at a speed not exceeding 6 km. (3.7 miles) an hour.

AUSTRIA. — Federal Railways.

If a station has no home signals, trains in case of crossing must both stop before running over the first set of points of the station. The entry of each train only takes place after the guard has made sure there is no hindrance, unless the train receives from the station the signal allowing it to enter.

SPAIN. — Northern Railways.

Nothing has been done in this respect.

HUNGARY. — Royal State Railways.

In stations where there are fixed signals with protection discs no speed restriction is prescribed.

RUMANIA. — State Railways.

Signals protecting stations have been retained.

CZECHOSLOVAKIA. — State Railways.

The speed of trains entering stations on secondary lines where there are no signals is not specially restricted. When a train approaches a station which is not protected by signals and in which it has to cross another train, the train arriving first must stop before crossing the points in order to allow the guard to throw the points, and, the second, await the « proceed » signal given by hand by the guard of the first train, which is now already standing in the station.

JUGOSLAVIA. — State Railways.

In case of crossing in a station having simplified signalling, when both trains arrive at the same time the station official must stop one or other of the trains outside the station.

QUESTION 17. — *Have you found it necessary to protect trains stopped on an open line? When this precaution is not obligatory, how is safety ensured?*

REPLIES.

ITALY. — State Railways.

On all lines, without any exception, trains stopped on an open line must be protected when the stop exceeds 10 minutes.

ITALY. — Piedmontese Tramways Co.

Yes.

AUSTRIA. — Federal Railways.

Same precautions as on main lines. Protection is not necessary in the case of shuttle services.

EGYPT. — State Railways.

We apply the block-system regulations.

SPAIN. — Northern Railways.

Yes.

HUNGARY. — Royal State Railways.
PORTUGAL. — Portuguese Railways Co.

Same precautions as on main lines.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Yes.

RUMANIA. — State Railways.

Protection is obligatory after a stop of 5 minutes, except on sections provided with the automatic block system, in which case protection is given by the automatic block signal.

SWITZERLAND. — Federal Railways.

Same precautions as on main lines.

CZECHOSLOVAKIA. — State Railways.

Generally speaking, trains at a standstill on an open line must be protected.

For protecting a train it is admissible to place detonators on the line or hand signals at a distance of 400 m. (440 yards) from the train that has stopped, whereas the distance at which this has to be done on main lines is 700 m. (770 yards). Equally, when it is necessary to protect a train towards the front, in case the train has unexpectedly to run backwards, an employee on the train must be stationed on the track at a distance of 400 m. from the moving train.

Only in the case of a shuttle service (worked with a single locomotive or railcar) is it not necessary to protect the train.

JUGOSLAVIA. — State Railways.

Yes.

QUESTION 18. — *May certain signals not be lighted at night? If so, must they be fitted with cat's eye reflectors? Must trains carry more powerful headlights than the usual lanterns?*

REPLIES.

ITALY. — State Railways.

Whenever traffic circulates all signals must be lighted at night. Two lantern showing a white lights of normal intensity are carried on the front of the trains.

ITALY. — Piedmontese Tramways Co.

No.

AUSTRIA. — Federal Railways.

Signals are lighted as on main lines. On secondary lines the head of trains carries a single lantern giving a white light.

EGYPT. — State Railways.

All signals are lighted at night and

engines carry the prescribed lanterns on all lines.

Electric headlights are being introduced gradually on the whole of our system.

SPAIN. — Northern Railways.

All our signals are lighted at night, except at stops on the open line to which we have already referred (No. 15).

We have no regulations as to the lighting power of lanterns on our trains.

HUNGARY. — Royal State Railways.

Certain signals at closed stations need not be lighted at night. They need not be fitted with reflectors.

The regulations do not require trains to carry headlights of greater power than usual lanterns.

PORTUGAL. — Portuguese Railways Co.

Signals must be lighted at night.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Not all signals are lighted at night. Locomotives have powerful headlights.

RUMANIA. — State Railways.

All signals are lighted during the night except at stations where no train movements occur; at such stations there is no lighting at all. Trains, however, carry the usual lights.

SWITZERLAND. — Federal Railways.

All signals have to be lighted.

CZECHOSLOVAKIA. — State Railways.

As a rule, headlights are used to warn of the approach of trains, and not to light up the track.

Home signals, etc., are so lighted as to fulfil safety requirements and regularity of working. Lines being closed to traffic during the night on most secondary lines, it is not necessary to light the signals.

On lines on which there is little night traffic, certain stations are closed during part of the night : in such cases signals are not lighted, but a special cross is installed to warn drivers they need not comply with same. (This measure is brought to the notice of the train staff.)

As a rule, the headlights are used only to warn of the approach of trains and not to light the track.

JUGOSLAVIA. — State Railways.

Signals must be lighted at night and never bear reflective devices. Headlights on trains do not differ much from the lanterns usually used.

QUESTION 19. — *Have you made any changes in the arrangement of points and crossings, in the working of same as well as that of signals which can give at least two indications?*

Do you apply in certain cases on secondary lines an economical system of distant working of points and signals? Please give a description of same.

REPLIES.

HUNGARY. — Royal State Railways.

No change has been made in the arrangement of points and crossings. On secondary lines there are no distant-controlled points.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

We are now installing these systems on lines carrying much traffic. We have points worked by wire-transmission, up to a distance of 400 to 500 m. (440 to 550 yards).

RUMANIA. — State Railways.

No distant-controlled points.

JUGOSLAVIA. — State Railways.

Points and signals on secondary lines are as rule simplified; a protection signal at a station only gives one indication ; we have no distant-controlled points.

The replies of the other Administrations are definitely in the negative.

QUESTION 20. — *How is the running of trains on secondary lines regulated?*

Is there a control station (one single station that is responsible for all movement on a section and which decides changes in the order of running of trains on a single track, changes of crossing places, the control of optional trains, etc.)?

In that case, has the staff of intermediate stations to share in the carrying out of regulations concerning the safety and running of trains?

What are, in this respect, the duties of guards?

Can the latter communicate with the control station?

Have you organised real train dispatching on secondary lines? If so, what are the technical means used for carrying that out economically? Does the dispatcher play any part in the shunting in stations?

Give a brief description of the dispatching system you have introduced and state whether such system enables the management of stations to be handed over to persons other than railway officials.

REPLIES.

ITALY. — State Railways.

On secondary lines of our system the running of trains can be regulated in 3 different manners :

a) In the same way as on our main lines.

b) By an economical « dispatching system which we call « Dirigente unico », viz. centralized train control.

c) By a simplified working system, applied on the Sicilian secondary lines.

Dispatching on secondary lines has the particularity that the train controller is responsible for all train operation on a given section of line; the station masters are mostly private individuals to whom, in general, we only confide commercial duties, whereas orders for the running of trains are given directly by the controller to train guards concerned.

By means of selector keys the train controller can get into touch with the post or station to whom he wishes to speak; he is constantly listening and any post on the line can place itself in communication with him without having to operate any call-key, by merely pressing on a pedal and speaking straight away.

The train controller must prepare a graph of the actual running of trains; he can thus follow all the movements, intervene in the spacing of trains and order guards on trains as to what shunting they must carry out at stopping stations.

The locking keys of points are kept by the person to whom a station is confided.

The controller decides as to the running of optional trains, including light engines; he also decides as to duplications, changes of crossing or overtaking places; as well as to, the cancelling of trains and all steps necessary to ensure regularity of working.

Any shunting in a station must be personally supervised by the guard; consequently no shunting can be done during periods when there is no train in a station. It is quite exceptional that a traffic official has to go purposely to a station for supervising shunting operations.

In order to keep the train controller constantly and fully acquainted with train movements and enable him to take the requisite steps, guards must announce to him their arrival at a station, stating the time of arrival, and the official or auxiliary employee in charge of a station must communicate to the controller the time of departure or passage of each train. The controller must also be informed of delays, the composition of trains, etc.

This system which has given the greatest satisfaction, both from the standpoint of safety and economy, has enabled us to hand over the management of stations to persons who do not belong to the permanent railway staff and to considerably reduce working expenses.

Dispatching of the type suited to lines carrying only a slight amount of traffic has been applied since 1925 to 5 500 km. (3 418 miles) of lines and the expenditure on wages has dropped by about 75 %.

On secondary lines, in Sicily, working is based on simplified prescriptions : only certain stations — the more important ones — are staffed by permanent railway employees and are responsible for traffic over a section of line : these stations are called « control stations ». As already stated in *question 2,* control stations have been entrusted with the faculty of regulating the succession of trains on their section, giving instructions for changes of crossing of trains, putting optional or special trains into circulation, etc. All orders are transmitted by telephone and recorded in telephone books.

In the other stations, not staffed by traffic officials, or at unguarded stopping places, the guard of the train has the responsibility for traffic (running) : nevertheless, the guard must in case of need get into communication with the guard of the train running towards him to arrange, in case of delay, the crossing without the intervention of the control station. As we have already explained, trains are classed as trains of greater or lesser importance than others running at the same time on one and the same section of line : it is the guard of the more important train who always has to take the responsibility of regulating the service if a control station does not intervene.

ITALY. — Piedmontese Tramways Co.

We have no control stations. In case of delay in the running of trains it is the station which has received notice of such delay which has to decide as to the change of place for crossing, by indicating this new place.

AUSTRIA. — Federal Railways.

Train running is regulated in the same manner as on the main lines. At less important stations one single employee may be entrusted with handling all the requirements of the service, viz. of course, traffic service. Regulations covering 126 pages, and of which it is not possible to give a summary, deal with this particular case.

EGYPT. — State Railways.

We have no control stations.

SPAIN. — Northern Railways.

The running on our secondary lines is regulated by the same prescriptions as on main lines. However, as traffic on our secondary lines is fairly light, it has been possible to close certain stations for certain periods of the day, which has enabled us to reduce the staff to an indispensable minimum.

Train control is no doubt very interesting, but we do not think it would be easy to adopt in our country this system of working, because the regulations now in force make it obligatory for stations to attend to requirements of the public and because, if this system were to effect real economy, it would be necessary to request rail users to attend personally to the loading and unloading of parcels when trains pass, which would be extremely difficult because the region is an agricultural one and users of the railway are very numerous, although the traffic is only light.

HUNGARY. — Royal State Railways.

The movement of trains is governed by the general timetables.

On certain lines there are control stations which regulate running as far as the next control station. In this case, the staff of intermediate stations takes no part in the movement of trains, although they have to observe certain prescriptions as regards safety; train guards then attend to all duties in connection with train circulation and they can communicate with the control station by telephone.

We have not applied the dispatching system to secondary lines.

PORTUGAL. — Portuguese Railways Co.

The running of trains on our secondary lines is regulated by telephonic or telegraphic communication from station to station.

We have no control stations, nor have we applied the dispatching system.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Yes. We have a control station on our shortest line (35 km. = 21.8 miles). On the others, traffic is regulated from station to station, although the control station in some cases also gives indications and even decides on the places for unforeseen crossings. Usually the latter, like overtakings, are fixed according to the permanent timetables, but when automatic signalling comes into service for regulating the running of trains, all traffic will be controlled from a centre-station. At present, the part of guards on lines carrying lighter traffic is to regulate, by telephone, the running of trains at localities where there is no staff; in other cases, to find out from station masters whether there are any orders or alterations in the running times as per timetables, and to act accordingly.

We employ no persons not belonging to regular station staff. When traffic is very light at some locality, we convert it into an unstaffed halt, and then guards have to attend to the goods services.

RUMANIA. — State Railways.

We are now studying the application of a simplified train control on secondary lines on which we have a maximum of 10 trips per day. As a result of the new system the staff of intermediate stations will not have to take any part in carrying out train control duties.

Guards' duties will be modified to suit. Guards can communicate with the control station only on the Ploesti-Fetesti petroleum-traffic lines.

Generally speaking, the « dispatching » system is the most used.

In no case has the management of stations been handed over to persons not belonging to the regular staff.

SWITZERLAND. — Federal Railways.

The running of trains is regulated in the same manner as on our main lines. The dispatching system is not applied.

CZECHOSLOVAKIA. — State Railways.

Working conditions on most of the secondary lines allowed us to introduce a *simplified dispatching system.* On these lines the simplification in question was in most instances preceded by the transformation of stations into « halts » having loading platforms. Train control in both directions is ensured by an employee called a regulator (or controller) who is stationed at a junction, crossing or other station in a suitable position on the line in question. For this purpose, all the shunting boxes and all stations on the line are connected by telephone.

The controller receives by telephone, from the guards of the various trains and the appointed employees at stations, the requisite notices of the running of their trains (notice of the entry of a train, train standing on a clear or occupied track) and gives them orders for the movement of trains, viz. change of crossing or overtaking place, announcing trains or giving notice of cancelled trains, advancing the booked timings of trains, trailers hauled and reliefs, load of trains, change-over of leading-in and out lines, signalling mid-day time, etc. Functions of a local nature are performed by guards. So far, this simplified method of train dispatching has been adopted on 157 of our lines totalling 4 221 km. (2 617 miles), which is about 1/3 of the lines worked by the Czechoslovak State. This system enables us, on principle, to entrust certain halts having loading platforms to persons who are not permanent railway officials. These persons act as intermediaries between the public and the railways. They are mostly members of the family (wives) of railway employees (see *question 34)*. As we have already stated, motorisation of passenger traffic on the lines in question has separated passenger traffic from goods traffic, so that mixed trains, which interfere with passenger traffic, have been eliminated. For passenger traffic, light railcars of Czechoslovak construction have given excellent results.

We are introducing the dispatching system only on our main lines.

JUGOSLAVIA. — State Railways.

Train sequence and intervals are laid down by the regulations; changes in crossing places are arranged by an appointed station; train control (dispatching) does not exist on our lines.

QUESTION 21. — *In case you have organised traffic as set forth in the preceding question, are train men (guards, brakesmen) entrusted with :*

- *the control of shunting movements?*
  the working of points?
- *the cleaning of points?*
- *the lighting of signals?*

If not, by whom are these duties carried out?

REPLIES.

ITALY. — State Railways.

As stated, head guards have to supervise shunting in stations and to work points. Signals are lighted by a station employee. When cleaning necessitates working a set of points, the station employee is supervised by a traffic employee.

SPAIN. — Northern Railways.

All these duties are carried out by station staff.

HUNGARY. — Royal State Railways.

Train staff perform shunting operations and work points, but the latter are cleaned by special staff.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Yes, in all unstaffed stations or halts.

RUMANIA. — State Railways.

Train men supervise shunting work, but the pointsmen work the points, clean same and light signals.

SWITZERLAND. — Federal Railways.

See *question 20.*

CZECHOSLOVAKIA. — State Railways.

Trains guards supervise the shunting work and work the points, if no station employee is entrusted with these duties.

The other duties, viz. cleaning switches and lighting signals, are carried out by a station employee, by a permanent-way man, or in exceptional cases, signals are lighted by a person who is not a railway employee (in most instances, some member of the family of a railway employee) and who is suitably remunerated for doing this.

JUGOSLAVIA. — State Railways.

See *question 20.*

QUESTION 22. — *Are stations on secondary lines open to all kinds of traffic (passengers, luggage, goods, animals, by ordinary goods train or fast goods train) on the same terms as stations on main lines? State restrictions, if any.*

REPLIES.

ITALY. — State Railways.

In general yes, if their installations

are suitable. The telegraphic service is sometimes replaced by telephone messages.

ITALY. — Piedmontese Tramways Co.

Yes.

AUSTRIA. — Federal Railways.

Stations on secondary lines carry out the same duties as those on main lines.

EGYPT. — State Railways.

Yes.

SPAIN. — Northern Railways.

On secondary lines, the needs of the public are attended to in the same manner as on main lines.

As stated, we have been able to reduce service-hours in stations, either for passenger or goods traffic, which proved very easy at stations on secondary lines, owing to the little traffic handled.

We have lines that are closed to traffic for a period of 8 hours and on such lines we have some stations which are not closed for 16 hours. As regards passenger and goods services there are also some shortened hours, as we have many stations which are only open to the service for 5 1/2 or 6 hours instead of 8 hours, as is required by normal dispositions.

HUNGARY. — Royal State Railways.

The same duties are assigned to stations on secondary lines as on main lines, and they are subject to the same restrictions. For instance, all stations are not open to livestock traffic.

PORTUGAL. — Portuguese Railways Co.

We have no lines that are legally classed as secondary lines. The conditions with which stations on so-called secondary lines have to comply are, generally speaking, the same as those for stations on main lines.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Yes.

RUMANIA. — State Railways.

We have stations of all categories.

CZECHOSLOVAKIA. — State Railways.

The extent of the forwarding-service on secondary lines depends (as on main lines) on the importance of local trade and on the equipment of the station.

JUGOSLAVIA. — State Railways.

Stations on secondary lines are open to all kinds of traffic which they can handle, on the same conditions as stations on main lines. Stations which are not equipped for all kinds of traffic have a restricted service as on the main lines.

QUESTION 23. — *How is the transport of goods organised on secondary lines?*

a) *Small consignments.*

b) *Complete wagon loads (mixed trains for passengers and goods, goods trains running only on certain days of the week)?*

REPLIES.

ITALY. — State Railways.

Both small consignments and complete wagon loads are carried. The latter are despatched by mixed trains or goods trains and they are usually sent off every day.

ITALY. — Piedmontese Tramways Co.

Goods are carried either as small consignments or complete wagon loads. Complete wagon loads are despatched by mixed trains or else by goods trains which are specially run when necessary.

AUSTRIA. — Federal Railways.

EGYPT. — State Railways.

In the same manner as on our main lines.

SPAIN. — Northern Railways.

The characteristics of our secondary lines are very varying. As a rule, it may be said that traffic by the following kinds of train is arranged on secondary lines : trains exclusively for passengers (railcar or steam); mixed trains for passengers and goods (steam); collector-trains for parcels; trains for ordinary merchandise.

In keeping with the characteristics of each line, all trains of the above mentioned types, or one or the other, run every day, with the exception of trains for ordinary merchandise which, where there is only a very little traffic, are not run every day.

HUNGARY. — Royal State Railways.

Goods on secondary lines are carried by :

a) Mixed trains or goods trains running every day : in the luggage-van or in pick-up wagons.

b) By goods trains, pick-up mixed, or special.

PORTUGAL. — Portuguese Railways Co.

Goods, both small consignments and complete wagon loads, are despatched by mixed trains.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Small consignments are carried in the usual way; complete carloads, wagon loads are despatched according to either of the two systems mentioned, specially when the large crops are being gathered in.

RUMANIA. — State Railways.

Goods are carried by goods trains and by passenger trains to which a special parcel van is coupled.

Mixed trains have been abolished.

A small number of full wagons may be coupled to passenger trains. If their number is considerable, we make up a goods train every 2 or 3 days, according to requirements.

SWITZERLAND. — Federal Railways.

In the same way as on main lines.

CZECHOSLOVAKIA. — State Railways.

The forwarding of complete wagon loads is usually done by a couple of goods trains; on lines where there are only a few loads (2-3 wagons) these wagons are coupled to mixed trains.

On a few secondary lines, passengers and luggage, and sometimes even parcels, are transferred to road transportation; on certain secondary lines the complete wagon loads are no longer accepted.

Transfer of traffic to the road is governed both by the desire to lower working costs and to give customers better facilities, granting them at the same time as regards goods traffic, all rate reductions applied to rail-borne traffic.

On lines with heavy traffic, parcels are carried in pick-up or distributor wagons, on lines with lighter goods traffic, in parcel-vans coupled to local passenger or mixed trains.

JUGOSLAVIA. — State Railways.

In the same manner as on main lines.

QUESTION 24. — *How are goods weighed, with a view to ascertaining the cost of transport?*

REPLIES.

ITALY. — State Railways
and
ITALY. — Piedmontese Tramways Co.

In the usual manner.

AUSTRIA. — Federal Railways.

As on main lines.

EGYPT. — State Railways.

We have weighing machines in all stations.

SPAIN. — Northern Railways.

As on main lines.

HUNGARY. — Royal State Railways.

Small consignments are weighed when they are handed in. Complete wagon loads are weighed in the station from which they are despatched, if such station has a weighbridge, or if not, in the nearest station, situated on the route of the wagon, that has a weighbridge. In this case, the station where the load is weighed communicates, at once and in writing, the result of the weighing to the station from which the load was despatched.

PORTUGAL. — Portuguese Railways Co.

Goods are weighed in the same way as on main lines, viz. small consignments on the station-scales, and wagon loads on the weighbridge, if the despatching-station is provided with these machines, or else wagons are weighed and rates applied at a nearby station on the route of the wagons, if the despatching-station has no weighbridge.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Many kinds of goods — vegetables, for instance — are not weighed. Rates are charged by bulk (volume). In some cases the consignors buy, in advance, labels which are pasted on to parcels not accompanied by any waybill. These labels are numbered and charges made out afterwards by an office.

SWITZERLAND. — Federal Railways.

In the same manner as on main lines.

CZECHOSLOVAKIA. — State Railways.

It is not possible to weigh parcels at « halts »; the weighing and checking is done at the nearest station on the route of the train.

As certain stations have no weighbridges, complete wagon loads are also weighed at the nearest station on the route of the train.

JUGOSLAVIA. — State Railways.

In the same manner as on main lines.

QUESTION 25. — *State the steps taken (if any) for lessening or simplifying the assessing of goods at stations on secondary lines. Can they ask a centre-station (or the dispatcher) to tell them the amount to be charged?*

REPLIES.

ITALY. — State Railways
and
ITALY. — Piedmontese Tramways Co.

There are no special measures.

AUSTRIA. — Federal Railways.

See reply to *question 23.*

EGYPT. — State Railways.

Certain quantities of goods may, in certain cases, be lumped together and assessed by the receiving station.

SPAIN. — Northern Railways.

There are no special rules in this respect.

HUNGARY. — Royal State Railways.

See reply to *question 2* b.

PORTUGAL. — Portuguese Railways Co.

All stations are able to assess consignments which they receive or send off.

RUMANIA. — State Railways.

Each station applies the rates. The station which delivers goods is responsible for the correctness of the rates applied.

SWITZERLAND. — Federal Railways.

All stations are responsible for operations in connection with all traffic they handle.

CZECHOSLOVAKIA. — State Railways.

In non-autonomous places (halts) parcels and packages are handed in for transport without waybills. In such *cases the weight of packages is usually* restricted to 50 kgr. (110 lb.) each and the weight of a whole consignment to 100 kgr. (220 lb.).

The waybill is only made out at the nearest station in the direction in which the train runs, which checks the consignment and its weight. A halt only issues a temporary receipt form for goods handed in.

JUGOSLAVIA. — State Railways.

The assessing of goods is done in the same way as on main lines.

QUESTION 26. — *Do the train staff (guards and brakesmen) issue tickets, check and collect tickets, register luggage, forward, deliver, handle and weigh goods, make up accounts, etc., at unstaffed stations?*

REPLIES.

ITALY. — State Railways.

Yes. Especially on railcars serving stopping places that are of quite secondary importance we allow, on certain services, tickets to be issued by the guards.

ITALY. — Piedmontese Tramways Co.

Passenger tickets are issued by the guard of the train. The checking is done by the head guard. In addition, tickets are specially checked — but not on all trains — by a control official.

Goods are checked at a transit station or receiving station.

AUSTRIA. — Federal Railways.

A definite reply is not possible because this question is decided according to local possibilities and circumstances.

EGYPT. — State Railways.

Train staff are authorised to issue and collect passenger tickets when passengers enter or leave trains at unstaffed places.

SPAIN. — Northern Railways.

The guard or head guard of railcars checks tickets, collects on the way any excess fares, issues tickets to passengers entering trains at unguarded halts, and delivers express goods which are carried on certain railcars.

HUNGARY. — Royal State Railways.

As regards the handling of goods, see sub. 2 *b*.

Among the staff travelling on trains, head guards and guards check and issue passenger tickets. They do not register baggage nor collect tickets.

PORTUGAL. — Portuguese Railways Co.

No.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Yes, they do all these duties as a rule.

RUMANIA. — State Railways.

Yes.

SWITZERLAND. — Federal Railways.

A few stations where there is very little traffic are closed when the first or last trains pass, and the passenger and luggage services are attended to by the train staff.

CZECHOSLOVAKIA. — State Railways.

In most cases, especially on short local lines, the head guard issues tickets, checks them and attends to the forwarding of luggage and parcels. So far, goods are not delivered direct from the trains by guards.

JUGOSLAVIA. — State Railways.

The train staff issue tickets, check and collect same and register luggage in unstaffed stations. Such stations are only open for passenger and luggage traffic, as on main lines. Such cases are rare.

QUESTION 27. — *Are there any instances in which a driver who drives a railcar alone issues tickets, checks and collects tickets at unstaffed stations and, in case of need, handles goods? What are the precautions taken to allow a driver to leave his stand? When railcars are manned by 2 employees (1 driver and 1 guard), does the driver, in* *case of need, help with the handling of goods, etc?*

REPLIES.

AUSTRIA. — Federal Railways.

A driver is usually not alone on a train, as the presence of a second employee is enforced by the Supervising Authorities. Only in quite exceptional cases (railcar services) is a single employee alone on a train when the speed is low.

When a driver is not alone he is not obliged to assist in his duties the other employee on the train.

SPAIN. — Northern Railways.

Our railcars are always manned by a driver and a guard; the driver does not assist the guard.

RUMANIA. — State Railways.

No. Each railcar has a guard.

— The other Administrations replied in the negative.

QUESTION 28. — *State the working hours (actually on duty — duration of intermittent work — extent of service) of staff travelling on trains (drivers and guards). Are they the same as those of employees travelling on trains on main lines?*

State the working hours (actually on duty — duration of intermittent work and extent of service) of station employees on secondary lines. Are they the same as those of the staff at main-line stations?

REPLIES.

ITALY. — State Railways.

For train staff the working hours are the same as on main lines.

As regards stations, the working hours are the same as on main lines if such stations are staffed by regular railway employees; if on the contrary stations are entrusted to auxiliary managers, the latter must be present when trains pass through. Owing to the length of this service, breaks are arranged for.

ITALY. — Piedmontese Tramways Co.

The working day of train and station staff is 8 hours 40 minutes.

AUSTRIA. — Federal Railways.

The working hours are fixed in the same manner as on the main lines; rest-hours are not provided for the staff travelling on trains on secondary lines.

EGYPT. — State Railways.

Working hours vary between 8 and 12. They are the same as on main lines.

SPAIN. — Northern Railways.

In accordance with the regulations in force, all our employees (except those in workshops) work 8 hours per day.

HUNGARY. — Royal State Railways.

The staff travelling on trains (head guards, guards, brakesmen) work as a rule, 300 hours a month, which can only be increased to 360 in exceptional cases. As a rule, uninterrupted service cannot exceed 16 hours, or 20 hours in exceptional cases, provided that during this time there is a rest period of 4 hours at least.

A rest of respectively at least 7, 8 and 12 hours must be granted after 12, 13 and 20 hours continuous service.

According to the intensity of the work, the working hours of station staff is 12 hours within 24 hours, followed in either case by 24 hours off duty. In certain small stations where duties are light and mainly consist in being present, we have organised a permanent service provided this permits six hours rest at night. Employees on duty at such stations receive a whole day off duty once a fortnight.

These working hours are identical to those in force on main lines.

PORTUGAL. — Portuguese Railways Co.

Working hours are very varying and are subject to the law on working hours. They are governed by the same principles as on main lines.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Employees may work a maximum of 16 hours per day and are obliged to do 96 actual hours work a fortnight. After 16 hours work they must have at least 10 hours rest.

The working hours of station hands are the same as those of our employees on main lines, but we only consider as actual work the time required for the running of trains. Other time is considered as standing-by hours and is reckoned at one third.

RUMANIA. — State Railways.

On the main lines the service is done by rotation, a maximum of 240 hours per month being allowed; on secondary lines the service is carried on in the same manner, but the maximum number of hours is 360 per month.

SWITZERLAND. — Federal Railways.

The dispositions of the law regulating working hours are applied without distinction to all officials on main and secondary lines. The actual working hours are 8 on the average; when the work is intermittent the average is 9 hours; maximum duration of service, 13 hours.

CZECHOSLOVAKIA. — State Railways.

The 8-hour law is applied, with the exception that on the secondary lines we calculate for the auxiliary work done by train staff, viz. before departure and after arrival of a train, a smaller number of hours than that reckoned for the same work on main lines. The service hours of station staff depend on the output of such personnel and are applied equally to main lines and to secondary lines. In the traction service, the working hours (including ancillary work on locomotives before and after the trips) may amount to 16 hours on secondary lines, whereas on main lines they are 9 hours for fast trains, 11 hours for local trains and 14 hours for goods trains.

JUGOSLAVIA. — State Railways.

Working hours are the same as on main lines.

QUESTION 29. — *Are all stations on secondary lines obligatorily staffed by permanent railway officials, or can their management be entrusted to a private person bound to the railway by a contract? Have any special precautions been taken for the selection of such persons and are the same working hours applied to them as to permanent railway officials, or are they considered as contractors on their own account? Have you entrusted to such private individuals duties concerning the safety of train running (accouncing departure and arrival of trains; working points, signals, level crossing gates, etc.)*?

REPLIES.

ITALY. — State Railways.

No; we have many stations on secondary lines that have been entrusted to private individuals who are under contract to the railway. These station « managers » or « caretakers » are chosen by competition and are considered as contracting parties.

These « managers » usually take no part in the running of trains; however, on lines worked by the dispatching system, their duties may include the announcing of trains, setting signals at « stop » or working certain points in case of crossing, but always after receiving orders from a dispatcher and only when being specially ordered to do so.

ITALY. — Piedmontese Tramways Co.

The principal stations are served by

regular railway employees. Secondary stations are confided to private persons, usually chosen from the ranks of retired railway officials.

AUSTRIA. — Federal Railways.

If the service at a station does not demand the whole time of an employee, the service may be handed over to a private person. If the latter is a retired railway official and belonged formerly to the train dispatching service, he may also be entrusted with looking after the train movements under given circumstances.

EGYPT. — State Railways,
and
SPAIN. — Northern Railways.

All our station staff are permanent railway officials.

HUNGARY. — Royal State Railways.

Station personnel on secondary lines belong to the permanent railway staff.

PORTUGAL. — Portuguese Railways Co.;
PORTUGAL (Colonies). — Lourenço-Marquès Railways,
and
RUMANIA. — State Railways.

No.

SWITZERLAND. — Federal Railways.

All the staff are permanent railway officials.

CZECHOSLOVAKIA. — State Railways.

See our replies to *questions 20 and 28.*

The service-hours of « caretakers » at halts having loading platforms are not governed by the 8-hour law, as applied to permanent railway officials. When choosing caretakers, we give the preference to members of the families of railway officials; the caretakers however, have to pass on examination beforehand. See also our reply to *question 21.* In certain cases they also perform barrier duties.

JUGOSLAVIA. — State Railways.

Stations on secondary lines, that are open to all traffic, must be staffed by permanent railway officials. There are stations having no regular station staff that are looked after by private individuals who have contracts with the railway, but they only issue tickets. Such stations are situated on lines where there is only a light traffic.

QUESTION 30. — *Are there unstaffed stations, i.e. stations where there is no representative of the railway except when trains stop there?*

If so, what kinds of traffic do such stations handle? How is the receiving and dispatching of goods done? Is it done by the staff of trains or railcars, and if so must the consignor or consignee be present when trains are due to pass through?

How does the consignee know that goods will arrive for him by such and such a train?

How is the weighing and assessing done?

REPLIES.

ITALY. — State Railways.

Yes. At these places nobody issues tickets nor looks after the service. Tickets are issued on trains by the guards. Such halts handle no goods traffic.

ITALY. — Piedmontese Tramways Co.
and
AUSTRIA. — Federal Railways.

No.

EGYPT. — State Railways.

We have certain stopping places where there is no staff. Tickets are issued and collected on the trains, but at such localities no goods are accepted.

SPAIN. — Northern Railways.

We only have a few unstaffed places

where railcars stop; tickets are issued on the railcar by the guard.

HUNGARY. — Royal State Railways.

See our reply sub *2/b*. In addition, according to the regulations the consignee is informed by a telephonic communication from the nearest station of the arrival of a consignment for him. He has to present himself at the place where such consignment is unloaded.

The weighing is done on the spot by an official from a station where the carriage charges are made out, if there is a weighing machine, or otherwise by a neighbouring station appointed for such purpose.

PORTUGAL. — Portuguese Railways Co.

No.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Yes. The traffic is handled either in complete wagon loads or in separate packages which are loaded into the vans by natives who accompany the guard. The public is usually bound to be present when trains pass through.

As a rule, consignees are informed of the arrival of goods by telephone by the consignor.

RUMANIA. — State Railways.

When passenger traffic at a stopping place is so light that it is unnecessary to have a staff there, tickets are issued on the train.

SWITZERLAND. — Federal Railways.

No.

CZECHOSLOVAKIA. — State Railways.

We have unstaffed stopping places. These halts are only used for passenger, luggage and express parcels traffic. Passengers have themselves to load their luggage or express parcels into the train and unload them afterwards. If a passenger does not himself unload his luggage or parcels, they are carried on to the next staffed station, which arranges for their delivery. Charges for registered luggage are only paid at the destination station.

At such halts goods are neither accepted nor delivered.

JUGOSLAVIA. — State Railways.

There are no unstaffed stations on our secondary lines.

QUESTION 31. — *Has the application of simplified working methods necessitated, in certain cases, the re-arranging of previous installations or the construction of special installations?*

REPLIES.

ITALY. — State Railways.

On lines on which we have installed an « economic dispatching » system we have made some alterations to stations that are not staffed by permanent railway officials. Such alterations consist in the locking of points, to provide greater safety for trains.

ITALY. — Piedmontese Tramways Co.,

AUSTRIA. — Federal Railways,

and

EGYPT. — State Railways.

No.

SPAIN. — Northern Railways.

We have only made a few small changes in the telephone and signal installations at stations that have an intermittent service.

HUNGARY. — Royal State Railways.

No, not as regards the handling of goods.

On certain lines, on which the working was simplified by way of a test, we installed a telephone line in order to establish direct communication with the control station. The loading tracks of stations where there is simplified working have had stop blocks placed at the ends of them, to prevent trains from going any farther, and the points of through tracks have been locked.

PORTUGAL. — Portuguese Railways Co.

No reply.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

No.

RUMANIA. — State Railways.

In our simplified train-dispatching scheme we intend retaining the present installations; points will be provided with a standard lock, in order to enable train guards to work all the points on the runs they make.

SWITZERLAND. — Federal Railways.

No.

CZECHOSLOVAKIA. — State Railways.

For the simplified dispatching of trains, we have installed a telephone line or converted the telegraph line into a telephone line.

JUGOSLAVIA. — State Railways.

As on secondary lines we apply the same commercial rules as on main lines, the installations are arranged to suit traffic requirements.

QUESTION 32. — *How are requests for empty wagons made by the public and how is the despatching of loaded wagons done?*

REPLIES.

ITALY. — State Railways.

As on main lines.

ITALY. — Piedmontese Tramways Co.

Requests for wagons can be made at all stations.

EGYPT. — State Railways.

Same regulations as on main lines.

Requests are usually made 24 hours in advance, if a 10-ton wagon is required, and 48 hours ahead if a wagon of over 10 tons is required.

HUNGARY. — Royal State Railways.

Requests for wagons are made through the assessing station. As to the reception and despatching of wagons, see our replies so *questions 2/b and 30.*

PORTUGAL. — Portuguese Railways Co.

As on main lines.

RUMANIA. — State Railways.

The control stations receive requests for empty wagons and despatch same.

SWITZERLAND. — Federal Railways.

As on main lines.

CZECHOSLOVAKIA. — State Railways.

Wagons are ordered either direct from a station that does the accountancy work or from a halt having a loading platform and authorised to accept such orders (the latter are transmitted by the halt to a fully staffed station) — or else indirectly when the « caretaker » is not authorised to accept orders for wagons. Such orders can be placed at a staffed station either in writing, by telegram or by telephone; a telephonic order can be given through the employee or « caretaker » of a halt.

As to the transportation of loaded wagons, see our reply to *question 23.* As regards unstaffed loading places, a waybill is made out either at the next station on the route of the train or at the station serving the loading place.

JUGOSLAVIA. — State Railways.

As on main lines. For stations handling only light traffic and small stations for which the accountancy and supervision is done by a neighbouring larger station, requests for empty wagons are received by accountancy stations which also despatch the loaded wagons.

QUESTION 33. — *How is the accountancy work of staffed and unstaffed* *stations done? Is there a centre-accountancy-station centralising all the accountancy work of a line? If so, what accountancy work remains to be done by a station superviser (station managed by a private individual) and how are goods despatched to their destination (is it obligatory to be via the centre-accountancy-station)?*

Describe, if the case occurs, the organisation of accountancy on a secondary line on which stations are not staffed constantly or are only managed by a person who is not a permanent railway official.

REPLIES.

ITALY. — State Railways.

From an accountancy standpoint the organisation of stations staffed by a private individual (caretaker) is the same as that of staffed stations, because we require the caretaker to know our system of accountancy and perform all the duties connected with it.

ITALY. — Piedmontese Tramways Co.

All stations are required to carry out accountancy work.

AUSTRIA. — Federal Railways.

No reply.

EGYPT. — State Railways.

Throughout our whole system, in each station an employee is responsible for periodical accounting and the handing in of same to the Head Office.

HUNGARY. — Royal State Railways.

At present, accountancy concerning passenger traffic at stations managed by a private person or not staffed permanently is done by the neighbouring stations which supply them with their stock of tickets and receive their takings.

The application of this system to a whole line is being considered.

PORTUGAL. — Portuguese Railways Co.

Accounts are kept at each station under the control of the central service and its inspectors.

There are no stations that are not staffed by permanent railway officials nor stations at which the accountancy of any given line is centralised. Neither are there stations at which the service is only intermittent.

PORTUGAL (Colonies). — Lourenço-Marquès Railways.

Accountancy of unstaffed stations is usually kept by centre-stations, in some instances by the nearest station. The organisation is the same as on the main lines.

RUMANIA. — State Railways.

In our opinion, all accountancy should be done by the centre-station. The caretaker of unstaffed stations acts as the medium between the station and the centre-station. He requests wagons in the name of the forwarder, loads them, seals them and sends them off to the centre-station which has to carry out all the formalities.

SWITZERLAND. — Federal Railways.

Each station keeps its own accounts.

There are no stations centralising all the accountancy of a whole line.

CZECHOSLOVAKIA. — State Railways.

Staffed stations do their own bookkeeping themselves, if they have an employee to carry out same. Otherwise, accounts are kept by a station appointed thereto, such method being also applied to stations that are staffed by a private person (caretaker).

Consignments are accepted and delivered direct to the consignee, without any intervention from the accountancy-station.

We have no stations centralising the accountancy work of a whole line.

JUGOSLAVIA. — State Railways.

See our reply to *question 32.*

QUESTION 34. — *State the number of stations where the simplified methods described in the foregoing* (questions 29 to 33) *are applied and to what extent these methods have been developed since 1930?*

REPLIES.

ITALY. — State Railways.

In all, 717 stations are no longer staffed by permanent railway officials : of these 536 have been converted since 1930.

ITALY. — Piedmontese Tramways Co.

We have 10 unstaffed stations, and the service has always been carried out very regularly.

HUNGARY. — Royal State Railways.

There are 9 such stations. We have not extended these methods.

RUMANIA. — State Railways.

So far, these simplified methods have not been applied, but they will be during the present year or from 1937 onwards.

SWITZERLAND. — Federal Railways.

See our reply to *question 33.*

CZECHOSLOVAKIA. — State Railways.

We have 240 halts with loading platforms and about 360 simple stopping places. About 30 % are staffed by railway officials; about 16 % by the wives or members of the families of railway officials; about 24 % by private « caretakers » under contract; about 30 % have no staff at all.

Thanks to our simplified dispatching of trains, we have, made an annual saving of about 6 000 000 Kc. (This system is applied at the present time on 157 lines having a total length of 4 211 km. = 2 617 miles).

See also reply to *question 20.*

JUGOSLAVIA. — State Railways.

No simplified working methods have been applied to our secondary lines.

* * *

According to the replies we have received to the questionnaire, and which are recorded above, we can draw up the following

General considerations.

The classification of a line in the category of secondary lines is frequently the consequence of the traffic being very light, but in certain countries, it is the result of an enactement of the Public Authorities. That is why several Companies have not attenuated or modified their working regulations on secondary lines, whilst still planning to simplify the working with a view to better adapt it to actual traffic requirements.

This conception necessarily entails the leaving aside of several sources of economy which could be taken advantage of to effect all the possible savings.

The modifications or attenuations of working regulations adopted by the various Administrations can be grouped into several categories, viz. :

a) Attenuation of running regulations: elimination of home signals at stations, simplified signalling in and out of trains, simplification of measures concerning the crossing and overtaking of trains, complete or partial elimination gatekeepers, reduction of the number of permanent way inspections, etc.

b) Restriction of hours of service in stations, either as regards passenger or goods traffic.

c) Simplification in the organisation of station work as regards delivery, forwarding, weighing, handling of goods, making out carriage charges, etc.

d) Simplifications in the regulations concerning rolling stock, viz. lessening of the number of periodic repairs of rolling stock used only on secondary lines.

As regards organisation of station work, most of the savings arise from the possibility of entrusting train staff with several duties which, on the main lines, are accomplished by the stations. As a rule it is the train staff who attend to shunting in stations, the cleaning of points, etc. It is the guard who has to bear in mind changes of crossing places, making the requisite arrangements with the control-station or dispatcher or else direct with the guard of the train running in the opposite direction, etc.

In this respect we find that Administrations have selected the type of organisation best suited to the nature of their own lines, traffic requirements, special operating conditions.

Each Administration has simplified as much as possible its working organisation, for the following reasons :

1. Lines on which traffic is only very light do not require working methods necessary when traffic is heavy;

2. Staff reductions in stations and on trains, which arises from the necessity for reducing expenses, requires a very simplified form of organisation.

As regards level crossings, we can see that most Administrations retain gate-keepers only where traffic is very heavy, whereas the majority of the other level crossings are left unguarded, warning signals being placed on either side of roads near level crossings, in order to call the attention of road users to the nearness of the railway.

Certain Administrations oblige drivers to whistle before reaching level crossings, in order to give additional warning to road users.

The economic working of secondary lines is necessarily based, as regards traction, on the use of suitable motive power : steam engines of a particular type, diesel locomotives, locotractors, railcars.

But railcars are really foremost in effecting real savings. Indeed, steam locomotives on secondary lines have not, generally speaking, undergone marked alterations in order to make them better adapted to economical operation.

The saving consists principally in the reduction of expenses on staff and fuel (reduction of cost price per railcar-kilometre); the advantages arise from the possibility of reaching a higher commercial train speed, with more frequent stops and a greater train frequency, which means a quicker and more suitable service for the public.

Nevertheless, if railcars give every satisfaction on lines carrying light traffic, one must admit that they cannot as a rule satisfactorily carry out the entire service on a line, for the following reasons :

a) The difficulty of coping with peaks of passenger traffic;

b) The difficulty, or sometimes the impossibility, of hauling complete wagon loads.

The first drawback can be remedied either by increasing the number of trips at rush times, by coupling trailers to railcars, or by running steam trains if necessary; the second difficulty is not easy to cope with, and that is why on lines worked by means of railcars at least a couple of steam trains have been retained.

Small consignments are usually carried by the same goods trains as complete wagon loads; if that is not possible a self-propelled van may be run.

The staff on railcars is usually very restricted : a driver and a guard.

If the guard cannot have access to the driver's cabin, in order to stop the vehicle if anything happens to the driver, the car is generally fitted with the « dead man's handle ».

Railcars are as a rule able to haul one or two trailers which are usually of special construction, in order to reduce to a minimum the total weight of the train. This is necessary to enable railcar trains to maintain the booked speed. For the same reason passenger classes on railcars are as a rule restricted to one or two; in most instances there is only third class.

In conclusion, railcar operation proves advantageous ; in particular, they give the possibility of :

a) Developing and even recovering traffic by increasing the number of runs, thanks to the lower cost price of the railcar-kilometre;

b) Increasing the average speed of trains and consequently shortening journeys;

c) Increasing, if necessary, the number of stops and thus giving a better service to districts;

d) Actually effecting considerable savings in working expenses.

On another hand, it must be pointed out that railcars are immediately ready for service, their preparation being reduced to a minimum.

* * *

From the train operating standpoint, we note that certain Administrations have found it advantageous to adopt, for controlling their train services, an organisation either by means of control-stations or by means of the dispatching system.

The part of a control-station is to regulate the running of trains on a line or section of line which is dependent on it : it is the control-station that has to regulate crossings, overtakings, make all changes in the workings of the line, order optional trains, cancel trains, transmit orders concerning the distribution of empty vehicles, and supply wagons to be loaded.

A control-station functions, upon the whole, like a dispatching office, but on a smaller scale.

The organisation of a service based on control-stations gives the possibility of almost entirely eliminating the staff of permanent operating employees in all other stations : this means a big saving and a considerable advantage as regards regularity of train running, owing to the unified command.

Instead of an organisation based on control-stations, and in general in cases where the working of secondary lines encounters some dificulty, either owing to the characteristics of the lines or periodical traffic fluctuations, certain Administrations have preferred to install a « simplified dispatching system », more in keeping with the more modest requirements of such lines.

The dispatcher or traffic controller has all the requisite powers to control train running and the service on the line and in the stations; he can call all the places by means of a selector telephone.

The traffic controller keeps a constant watch on the running of the trains and draws a graph thereof.

All stations under the dispatcher (except some junction stations or stations of special importance) are handed over to « caretakers » who are not permanent railway officials.

The equipment of stations on secondary lines worked on the dispatching system have, in addition, point-locks with keys, so that trains entering such stations always find the points locked in accordance with the track they have to run over. Points are always worked under the supervision and according to the orders of the guard of such train as is standing in the station.

Further, the guard has to supervise shunting, and thus the station employee or auxiliary caretaker never has to touch the safety installations without orders from a guard or the dispatcher.

This system of economical dispatching has given good results in the working of secondary lines and has enabled railways to effect considerable savings on staff, without safety being affected.

* * *

As a rule, stations on secondary lines are open for all traffic and if there are any restrictions they are due in most instances to the characteristics of the installations.

Small consignments of goods are carried either by the ordinary methods (pick-up trains) or by motor vans; complete wagon loads are almost always forwarded by goods trains or by mixed trains (passenger and goods).

Wagons are weighed at stations as on the main lines, and if a station has no weigh-bridge the weight is checked at some neighbouring station. As regards the charges, stations which accept consignments usually also make out the charges; likewise, accountancy work is usually carried out by the forwarding stations or in some instances by accountancy centre-stations duly appointed.

On secondary lines the necessity arises for train staff to issue, check and collect tickets en route, register luggage, deliver goods (small packages), in connection with places where there is no staff. But as a rule such duties are not required from railcar drivers.

The working hours vary and it is not possible to give data of a general nature because the hours often depend on the legislation of the various countries. Nevertheless, Administrations, when possible, so arrange the working hours as to take into account long breaks which occur on secondary lines.

As already stated, places with very little traffic, mainly passenger, are not staffed; otherwise, such places are often looked after by persons who do not belong to the regular railway staff.

A commercial organisation that complies with the above general principles usually provides a satisfactory service for the public, whilst reducing expenses to a minimum.

SUMMARY.

1. Secondary lines should be built and equipped in such a manner as to permit of economical working (stations staffed by private individuals, unguarded level crossings, telephonic train signalling, etc.).

2. The train-operating service should be concentrated at selected stations (control-stations) or at regulating offices (dispatching), for the purpose of reducing as much as possible the traffic staff in stations.

3. The experience gained and the results obtained since the introduction of railcars shows that confidence can be placed in this method of traction, mainly for passenger services but also, in certain particular cases, for small consignments of goods.

4. By the use of railcars, with or without trailers, the journey times can be shortened, the train frequency and number of stops increased, and the services on secondary lines can be much improved as a whole.

5. Railcar services have helped considerably to recover traffic which had been diverted to the road.

[656. 27]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION VII.

Economical operation of the main line systems' secondary lines. Various methods adopted to adjust the operating facilities, safety measures, and station organisation to the volume of traffic.

REPORT

(Germany, Great Britain, Dominions and Colonies, Denmark, Finland, Norway, Netherlands and Colonies, Poland and Sweden),

by T. EMERS,

Inspecteur en chef supérieur du service de l'exploitation, Direction générale des Chemins de fer de l'État (Sweden).

I. — Preamble.

Our questionnaire referring to question VII was sent out to all the Railway Systems and Companies in Germany, Great Britain, its Dominions and Colonies, Denmark, Finland, Norway, Holland and its Colonies, Poland and Sweden, members of the International Railway Congress Association, or in all 69 Administrations; 33 replied to this questionnaire; among the latter, 26 gave us complete and detailed replies; these are :

Germany :

Deutsche Reichsbahn Gesellschaft.

Denmark :

State Railways.

Great Britain, Northern Ireland, Dominions and Colonies :

Great Western Railway.
London Midland and Scottish Railway.
London and North Eastern Railway.
Southern Railway.
Midland and Great Northern Railways Joint Committee.
Kenya and Uganda Railways and Harbours.
South African Railways and Harbours.
Bombay, Baroda and Central India Railway.
Burma Railways.
Great Indian Peninsula Railway.
North Western Railway.
East Indian Railway.
South Indian Railway.

County Donegal Railways Joint Committee.

Great Northern Railway.

Irish Free State :

Great Southern Railways.

Netherlands :

Netherlands Railways.
State Railways in the Dutch Indies.

Poland :

State Railways.

Sweden :

State Railways.

Private Railways.

Bergslagen Railway.
Halmstad-Nässjö Railway.
Hälsingborg-Hässleholm Railway.
Västergötland-Göteborg Railway.

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Owing to the growing competition between railways and road transportation, Railway Managements have been gradually led to improve their operating methods, especially on lines carrying only light traffic. In this respect the situation in the various countries would certainly have been made clearer, if we had received more numerous and detailed replies to our questionnaire. In our opinion, one of the reasons for the shortage of replies lies in the difficulty of deciding as to what characteristics enable certain lines in a system to be, or not to be, considered as secondary lines. In certain cases it appears to be very difficult to make a distinction between secondary lines and local lines (or lines called by other terms). In some countries, such as Great Britain, the term « branch lines » is used for « secondary lines »; in others, such as Denmark and Sweden, this term does not exist, at any rate officially.

In our opinion, secondary lines may exist in standard-gauge systems just as well as in narrow-gauge systems, the essential point being that the equipment of a given line, when built has been adapted to the light traffic anticipated on such a line.

It is evident that lines having a light superstructure, and on which the operating conditions are simpler as compared to elsewhere, are naturally classed as secondary lines.

We consequently presume, in the present report, ignoring the track gauge question, that secondary lines exist on all railway systems, and we include in the term « secondary lines » the expressions used in Great Britain such as « branch lines », « cross country lines » or similar terms used in other countries.

II. — Questions of a general nature.

QUESTION 1. — *Is the classing of a line of your system as a secondary line the result of an act of the Public Authorithies ? Or do you designate under the name of « secondary line » all your lines carrying only light traffic ?*

The replies received show that as a rule it is incumbent on railway Administrations to decide as to whether a given line should be, or should not be, classed among secondary lines and worked according to such simplified methods as may be prescribed for this kind of railway. In most instances no formal decision in this respect is made by the Public Authorities.

The *Deutsche Reichsbahn* states, however, that it is incumbent upon the competent Minister to decide whether a railway open to general traffic should be classed as a main or secondary line.

The *Southern Railway* (Great Britain) reports that its secondary lines are classed as « light railways », i. e. lines on which a maximum speed of 25 miles

(40 km) is allowed. Their construction was authorised by an Act of Parliament in 1896, in order to further the building of railways in districts in which it was not considered economic to build lines having the characteristics of a main line.

Similar standpoints were put forward by the *London & North Eastern Railway* as regards certain of its « branch lines ».

The *North Western Railway* (State Railways of India) states that its lines are grouped into « main and branch lines » according to the following rules, this classification not being the result of any decision made by the Public Authorities :

Main lines. — Category « A », applied when the traffic amounts to 3 million tons. Minimum weight of rails : 90 lb. (44.6 kgr.).

Category « B 1 », applied when traffic ranges from 3/4 to 3 million tons per annum. Minimum weight of rails : 75 lb. (37.2 kgr.). These lines are not built to carry either fast or heavy traffic.

Branch lines. — Category « B II », applied when traffic ranges from 3/4 to 3 million tons. Minimum weight of rails : 75 lb. (37.2 kgr.).

Category « C » : up to 3/4 million tons. Minimum weight of rails : 60 lb. (29.8 kgr.).

Category « D » : 2′ 6″ (0.76-m.) gauge lines.

Netherlands Railways. — The classification depends upon an Act passed by the Public Authorities, having as a basis the maximum speed laid down (up to 75 km. = 46 1/2 miles per hour).

The *State Railways in the Dutch East Indies* state that the classification of all railway lines in the Dutch East Indies (both State and private lines) is enacted by the Public Authorities (Decrees by the Governor General of the Dutch Indies), according to the maximum authorised train speeds, as follows :

1st-class railways : V max. $>$ 60 km. (37.3 miles).

2nd-class railways : 20 km. (12.4 miles) $<$ V max. $<$ 60 km. (37.3 miles).

Urban tramways, designating in particular urban and suburban methods of transport. The maximum speed of trains allowed on this category does not usually exceed 30 km. (18.6 miles).

Rural tramways, serving comparatively restricted areas. The maximum train speed does not exceed 20 km. (12.4 miles).

All the secondary lines (viz. lines carrying lighter traffic) are classed in the 2nd-class group — unlike main lines which belong to the 1st-class group of railways.

Polish State Railways. — The lines are classified in various categories by a decree dated 7th February 1934, issued by the Minister of Communications, according to the method of construction, traffic, train speed, etc.

In *Sweden* schemes for the construction of railways were, from the start, drawn up on the hypothesis that the main lines would be built and worked by the State and the other lines by private concerns. That is why the secondary lines were only built after completion of the main lines. Although there is no formal decision on the part of the Public Authorities to class certain lines as « secondary », it was agreed, however, that owing to the light traffic anticipated on these lines, the rigorous conditions laid down for the construction of main lines should not be applied to them. In view of the vast and thinly populated regions in the Northern part of the country, the number of these secondary lines has become important : 2 265 km. (1 407 miles) of the State railway system (in all 7 526 km. = 4 676 miles), or about 30 % may be considered as belonging to the category of « secondary lines ».

QUESTION 2. — *Are there, on your system, special working regulations, applicable to secondary lines, which differ from the regulations applicable to main lines, and if so :*

a) *to what extent do they alleviate the safety measures and train running regulations as applied to main lines (dispensing with signals — special conditions for announcing trains — unguarded level crossings — inspection of permanent way, etc.) ?*

b) *do they authorise a reduction of the daily hours stations are open to the public ? Are not certain stations only open for the forwarding and delivery of goods during train stops ?*

c) *do they allow of a reduction in the number of repairs to rolling stock running exclusively on secondary lines (passenger and goods) ?*

Do you observe the same rules for the braking of trains (passenger or goods) on secondary lines as on main lines? If not, state the principal differences.

It does not appear that special operating regulations applicable only and specially adapted to secondary lines, exist. On the other hand, it appears from the replies received that in certain instances there do exist exceptional regulations enabling operation in a simplified form to be carried out. Such is the case on the *Swedish State Railways*, which have drawn up « Simplified Safety Rules for the operation of lines carrying light traffic », which make exceptions to the general safety regulations. These simplified rules can only be applied after authorisation by the administration in certain given cases and are at present entirely in force on 22 lines and partially on 15.

It seems, on the other hand, that as regards signals as well as the connection between points and signals, there are fairly numerous alleviations in favour of secondary lines.

Thus, the *Deutsche Reichsbahn* stipulates that the home signal is not prescribed at the entrance to junction stations on lines on which the maximum speed does not exceed 40 km. (25 miles). It is not necessary to protect points and crossings, on an open track, by stop signals. Neither is it necessary to make the points in a station dependent on the signals that regulate the running, nor having home signals preceded by distant signals. Point indicators are only demanded for leading-in points which are not protected by a home signal, or which are usually locked. Locking or supervision of facing points is not demanded during the passage of trains. On the other hand, the maximum speed on secondary lines is, as a rule, fixed at 40 km. (25 miles), but can be raised to 50 km. (31 miles) for trains fitted with continuous brakes or when the general conditions rather resemble those on main lines. However, exceptions are allowed in actual practice and permit speeds up to 60 km. (37.3 miles) and even more on isolated runs. As regards the composition of trains, light vehicles with a not too heavy axle load are used.

On the *London & North Eastern Railway* the signals on secondary lines are restricted to a number sufficient to provide for safety in operation. On lines on which « light railway » regulations are applied, approach signals are not obligatory unless the stop signals — if there are any — cannot be seen from a distance of a quarter of a mile.

The *Southern Railway* reports that in certain cases signals are abolished except at crossing stations.

On the *County Donegal Railways* approach signals are not used, owing to the very low speed of trains (25 to 35 miles).

The *South Indian Railway* states that one stop signal is the minimum in each direction and that this signal must be placed at a sufficient distance from the end facing points. The number of trains is in this case restricted to three in each direction and the maximum speed is 20 miles on metre-gauge lines and 25 miles on standard gauge. A similar speed reduction has been applied to other Indian railways.

The *East Indian Railway* reports that all the signals may be ignored during day-time on lines that carry a very light traffic, the working being on the « one engine in steam » system.

The interlocking of points and signals is not obligatory on the *Danish State Railways* when the maximum speed does not exceed 75 km. (46.6 miles).

The *Dutch East Indies State Railways* allow simplifications as regards signalling when the maximum speed does not exceed 45 km. (28 miles).

The *Swedish State Railways* only use signals in junction stations at which several lines converge and where local circumstances require signals. At other stations there are no signals but the points and stop blocks are locked by means of a padlock which can only be opened by a key carried by the train guard. Such places can only be run over at a maximum speed of 40 km. (25 miles) which, in case of need, can be even further reduced. The maximum speed on secondary lines is, moreover, fixed at 60 km. (37.3 miles) for steam trains.

The *Swedish Private Railways* have unstaffed halts without any home signals; points must be locked and provided with indicators which replace home signals. Maximum speed : 40 km. (25 miles).

The method used for signalling-in trains on secondary lines does not differ as a rule from that used on main lines.

On the *Deutsche Reichsbahn* the signal boxes that regulate the succession of trains must be connected by telegraph on lines on which the highest speed allowed exceeds 40 km. (25 miles). Elsewhere, a telephone connection is sufficient and, even in certain cases, this latter form of connection is tolerated for running speeds up to 60 km. (37.3 miles). Main-line regulations fixing the distance between signal boxes, regulating the succession of trains and crossing (junction) stations, are only applied after a decision has been taken by the competent Minister.

On the *British* and *Irish Railways* the « absolute block » system is much used on double lines, and special systems such as the « electric token », « wooden staff », « Neal's ball token », « paper line clear ticket », etc., on single lines.

The *Dutch East Indies State Railways* allow a simplified method of signalling-in trains when the maximum speed does not exceed 45 km. (28 miles).

On the *Swedish State Railways*, where the telegraph is no longer used, trains are always signalled-in by telephone. As the distances between two staffed stations are often very long, it is allowed, in case of need, for a train to enter part of the following section — the second half of which is occupied by another train — the two parts of the section being separated by an unstaffed station. In such a case, the track is cleared as far as the latter station, and the driving and train staff are informed of this. On arrival at this boundary-station, the head guard obtains permission by telephone (all stations on lines of this kind are fitted with telephones) to proceed and informs the driving staff of this. The head guard can also, if required, clear the part of the section over which the train has just passed. The obligation of staffing stations for signalling-in and back the trains may in case of need be mitigated.

As to unguarded *public level crossings*, it appears that there are only rare instances of this in Great Britain and Ireland. It is, on the contrary, a rule that gate-keepers be used when the barriers are not worked from a signal box. The

London & North Eastern Railway reports that on lines of minor importance, such as goods lines, the barriers of crossings may normally be closed against the train traffic, i. e. giving passage to road traffic. Train staff in this case work the barriers. On the contrary, public crossings on « light railways » are as a rule unguarded. There is no fencing, but in order to prevent cattle from straying on to the line « cattle guards » are placed on both sides of the line. Notices posted on either side of the railway warn the public. Drivers must, moreover, give warning by whistling and reduce speed in accordance with signs placed along the line and on both sides of the crossing. On the *Deutsche Reichsbahn* level crossings are not protected by barriers or other means unless traffic is intense. An exception is made for crossings where there is a clear view, which are crossed by trains at a maximum speed of 15 km. (9.3 miles). Appliances warning gate-keepers of the departure of trains (bell alarms) are only required on lines on which speeds may exceed 40 km. (25 miles). At unguarded level crossings (one or several lines), the rule is to place warning-crosses of a different shape to those placed at protected level crossings. Level crossings at which traffic (especially automobile traffic) is more intense are provided by the road authorities with special warning signs (a locomotive emitting smoke) placed at 150 to 200 metres (165 to 220 yds) from the railway. It was recently prescribed that at all important level crossings — in the first instance at those of the « Reichsstrassen » (State highways) — warning signs, supplemented by other signals, are to be installed to the right and left of roads. Additional signs of this kind are to be placed to the right and left, at 2/3 and at 1/3 of the above mentioned distance. At several much used crossings, barriers have been replaced by warning-lights, i. e. beneath the warning cross a white winking light lights up when a train is approaching, changes to red when the train reaches the crossing and winks twice as fast as the white light. At several crossings where visibility is poor, powerful bell-signals worked by approaching trains have been installed. Before reaching unguarded level crossings special indicators are placed on the railway track, of varying shapes according to the visibility and intensity of traffic, to warn drivers to sound bells, whistle or else slow down. These methods can also be combined. On the *Danish State Railways* the guarding of level crossings is not required on lines on which the maximum speed does not exceed 75 km. (46.6 miles). On the *Netherlands Railways* level crossings are not as a rule guarded. The *Dutch East Indies State Railways* allow a mitigated guarding when the maximum speed does not exceed 45 km. (28 miles). The *Swedish State Railways* use automatic signals, which are cheaper than gate-keepers. Their first cost is usually borne by the railway.

On the *Swedish private railways* the rule is to provide level crossings with gate-keepers when the barriers are not worked from a signal box. In certain cases, however, there are unguarded level crossings. At crossings over main roads, trains are bound to stop and not to proceed before making sure that the road is clear. At other crossings they have to reduce speed.

We have not taken into account here crossings of a private nature, situated within large estates that extend on both sides of a railway, as well as crossings for pedestrians.

As regards *track inspections,* there are certain alleviations or else the service has been so organised as to avoid loss of time. On the *Great Western Railway,* lines are grouped for this purpose into three categories according to the nature of the traffic. On the *London & North Eastern Railway* the rule is for the flag-men to make one inspection tour per day on the block-section, but there are also modifications that allow one single inspection at certain intervals. On the *Dutch East Indies State Railways* the obligatory number of daily inspections is reduced on secondary lines on which the maximum train speed does not exceed 45 km. (28 miles). On the *Swedish State Railways* and several other railways inspection tours are reduced to one per diem and can be done by trolley, but once a week this has to be done afoot.

In this respect it should be mentioned that, according to the experience gained by the *Country Donegal Railways*, it has been possible to considerably reduce the staff of gangmen owing to the use of railcars which have, moreover, proved to be less destructive of the track.

Generally speaking, no reduction of the *daily opening-hours* of stations (as compared to main lines) appears to be made, judging by the replies received. It appears to be a rule that stations should be open to the extent required by the transport of passengers and goods in a district. On the *Dutch East Indies State Railways*, however, part of the stations on secondary lines are only open to the public at certain hours of the day, according to the amount and nature of passenger and goods traffic. The same applies to the *Swedish State Railways*, where rational reductions have been made, enabling women to be employed for station service. On the *County Donegal Railways* several stations have recently been changed into « halts », which are only served by staff at certain hours for the acceptance and delivery of goods. On the *London Midland & Scottish Railway*, goods are not accepted at unstaffed halts.

As to *inspection of rolling stock* running only on secondary lines, it should be noted that the time between two successive inspections is not as a rule prolonged; in most instances the running of rolling stock is not confined exclusively to secondary lines. The workshops which carry out repairs decide as to the advisability of so doing. Locomotives running on secondary lines usually do longer runs than those that have to do more arduous and faster work. The *Deutsche Reichsbahn* states that the intervals between repairs of locomotives, railcars and goods wagons in service both on main lines and on secondary lines are always the same. Passenger coaches, postal vans and guard's vans running solely on secondary lines are overhauled every three years at least, whilst on main lines these inspections are more frequent.

On the *London & North Eastern Railway* passenger coaches used for secondary traffic are usually only overhauled every five years and goods wagons every seven years. For this latter category of vehicles, it is not easy to make any clear distinction between those running on main lines and those used on secondary lines. On the *Dutch East Indies State Railways*, for secondary lines on which the maximum speed exceeds 30 km. (18.6 miles), but does not reach 60 km. (37.3 miles), the time between two successive overhauls is longer than the corresponding periods on main lines. When the maximum speed does not exceed 30 km. the interval between two overhauls depends upon the general condition of the rolling stock in question.

There is not, as a rule, any difference as regards *braking rules* between trains (passenger or goods) on main lines and those on secondary lines. Nevertheless, on the *Deutsche Reichsbahn* trains must have such a number of brakes in action that the braking distance does not exceed 400 m. (440 yds) on secondary lines (700 m. = 770 yds on main lines). On secondary lines on which gate-keepers can be informed of the departure of trains by bell-alarms etc., on which junction stations are equipped with home signals and on which all crossings without barriers and where visibility is poor are guarded, the competent Minister may order the same braking ratio as on main lines. Only the *Polish State Railways* report that on secondary lines the braking-distance may be reduced to 400 m. (440 yds), that on main lines being fixed at 700 m. (770 yds).

QUESTION 3. — a) *Is the working of your secondary lines done by services distinct from those which work the remainder of your system ?*

b) *Have you entrusted the working of your secondary lines to private undertakings (light railways, tramway companies, other transport undertakings, etc.) ? If so, state the more interesting conditions of contracts made with such undertakings; are the latter interested in the working results ?*

It appears from the replies received that secondary lines are, in several instances, worked by services distinct from those that operate the remainder of the main-line system. That applies to the *Great Western Railway*, the *Southern Railway*, the *County Donegal Railways* and the *North Western Railway* (State Railway of India).

On the contrary, on other railways there is no difference between the working of main lines and that of secondary lines. On the *London Midland & Scottish Railway* passenger traffic on secondary lines that are only slightly remunerative has been abolished; passengers are, instead carried in motor omnibuses belonging to undertakings in which the railway is financially interested. The *Swedish State Railways* have, in one single instance (on the Övertornea-Pajala section, 116 km. = 72 miles) organised a road service which is entirely operated departmentally; only the driving and maintenance is done under contract. In other cases the *State Railways* have organised or bought up omnibus services which are operated departmentally or contracted for. The operation of the secondary lines is managed by distinct officials when the length of the lines requires it or else by officials also entrusted with the management of certain main lines.

In no instance are secondary lines worked by private undertakings.

III. — **Means of transport used.**

QUESTION 4. — *Do you use on secondary lines, for passenger, goods and mixed (passenger and goods) trains motive power having special characteristics :*

— steam engines of a particular type or having undergone considerable transformations as compared to engines of the current type (appliances facilitating loading of fuel into the firebox, etc.);

— diesel-engined locomotives — tractors — railcars ?

Steam locomotives of a special type do not appear as a rule to be used.

On several *English Railways* there are on certain « branch lines » « push and pull » trains usually composed of 2 or 3 coaches. The engines are tank locomotives of a usual type, apart from the installation of distant control which is usually done by hand, but also with the aid of compressed air from the Westinghouse or vacuum brake. Thanks to this installation, the engine can be controlled from the driver's cab or from a cabin situated at the other end of the train and placed in communication with the locomotive by means of appliances running through three coaches at the most. This arrangement avoids engine shunting at terminal stations.

On the *South African Railways* the locomotives intended for use on secondary lines are either of a special type, owing to the restricted axle-load on these lines, or old main-line locomotives. The introduction of modern types such as the *Garratt* and *19-C* has made it pos-

Light steam locomotives. — Steam railcars

[illegible]	[illegible]	[illegible]	Wheel diameter. driving	Wheel diameter. carrying	Cylinder bore.	Piston stroke.	Horse-power.	Total weight.	Adhesive weight.	Load that can be hauled on the level.	Maximum speed on the level miles (km.).	Cost price per mile or km. run.	Average daily distance covered, miles (km.).	Staff. Number of men.	Name of builders.	Length over buffers.	Weight empty.	Number of passengers carried in each class. seated.	standing.	Number
							London Midland and Scottish Railway.													
			.	...	...	...	...	...	...	...	...	...	...	...	Sentinel	60' 2" (18.30 m.)	24.93 Engl. t. (25.3 met. t.)	44		
			..	...	...	...	...	...	...	...	...	...	...	...	»	58' (17.68 m.)	21.35 Engl. t. (21.7 met. t.)	44		
							London and North Eastern Railway.													
35 (3.25)	36.5 (3.38)	275 (19.3)	3' 1" (0.94 m.)	3' 1" (0.94 m.)	6 3/4" (171 mm.)	9" (228 mm.)	100	25.5 Engl. t. (25.9 met. t.)	19 t. 10 c. (19.8 met. t.)	...	36 (58)	...	...	2	Sentinel	61' 5" (18.70 m.)	28 t.	60	...	1
36.5 (3.38)	36.5 (3.38)	300 (21.1)	3' 1" (0.94 m.)	3' 1" (0.94 m.)	6" (152 mm.)	7" (178 mm.)	100	29.1 Engl. t. (29.5 met. t.)	23 Engl. t. (23.4 met. t.)	...	60 (96)	...	142 (228)	2	»	62' 8" (19.10 m.)	31 t.	59	.	1
58 (5.38)	272 (25.3)	1250 1500	3' 1" (0.94 m.)	3' 1" (0.94 m.)	6" (152 mm.)	7" (178 mm.)	200	42.6 Engl. t. (43.2 met. t.)	27 Engl. t. (27.4 met. t.)	...	60 (96)	...	153 (246)	2	»	65' 8" (20.01 m.)	...	54	.	1
56.5 (5.25)	231 (21.5)	300 (21.1)	3' 1" (0.94 m.)	3' 1" (0.94 m.)	6" (152 mm.)	7" (178 mm.)	200	41.5 Engl. t. (42.1 met. t.)	29 Engl. t. (29.5 met. t.)	...	60 (96)	...	153 (246)	2	»	69' 2" (21.08 m.)	...	48	...	1
58 (5.38)	272 (25.3)	300 (21.1)	3' 1" (0.94 m.)	3' 1" (0.94 m.)	6" (152 mm.)	7" (178 mm.)	200	105.7 Engl. t. (107.4 met. t.)	55 Engl. t. (55.9 met. t.)	...	60 (96)	...	155 (250)	2	»	110' 2" (33.60 m.)	...	122	..	1
							Bombay, Baroda and Central India Railway.													
			...	...	...	...	...	...	...	...	...	...	...	...	Sentinel.	102' 11" (31.40 m.)	47.75 Engl. t.	« Upper » 12 « Lower » 99-104	...	...
							East Indian Railway.													
35 (3.25)	36.5 (3.38)	275 (19.3)	2' 6" (0.76 m.)	2' 6" (0.76 m.)	2 — 6 3/4" (171 mm.)	9" (228 mm.)	...	38.4 t. (39.0 met. t.)	19.3 Engl. t. (19.6 met. t.)	...	35 (56)	2.4 annas per mile	33.9 (54.5)	2	Sentinel	103' 10" (31.65 m.)	36.9 Engl. t.	« Upper » 10 « Lower » { 76 men 14 women	...	1
							Great Southern Railways.													
35 (3.25)	36 (3.35)	275 (19.3)	2' 6" (0.76 m.)	...	6 3/4" (171 mm.)	9" (228 mm.)	...	20-25 t.	...	200 tons.	33 (53)	...	...	2	Sentinel	...	...	..		
35 (3.25)	36 (3.35)	275 (19.3)	...	...	6 3/4" (171 mm.)	9" (228 mm.)	...	20 t.	...	...	...	...	...	2	»	62' 5" (19.02 m.)	21.45 Engl. t. (21.8 met. t.)	55	..	1
							Polish State Railways.													
[illegible]	[illegible]	19 atm.	1 060 mm.	1 000 mm.	177.8 mm.	254 mm.	100-150	27.6-40.8 met. t.	...	20-ton wagon	60-70 km.	1.12 zloty (¹)	250 km.	2	Clayton	15.8 m.-16.0 m.	25-36.1 t.	65-70	32-35	1
[illegible]	[illegible]	21 atm.	762 mm.	762 mm.	152.4 mm.	177.8 mm.	100	31.2 met. t.	...	»	70 km.	1.30 zloty (¹)	250 km.	2	Sentinel	16.9 m.	30 t.	63	30	1

(¹) Per km. — 1 zloty = 0.58 gold-fr. approx.

Railcars or locotractors

[illegible] Diesel, etc.	service.	in service.	passenger.	goods.	mixed pass.-goods.	Name of builders.	Ft.-in.	Metres.	Engl. tons.	Metr. tons.	capacity. Seated.	Standing.	Goods compartments Number.	Floor area Sq. feet.	M²	Loading capacity. Engl. tons.	Drivers cabins Number	Location.	Staff.	Buffing gear.	Brakes.	Engines. Builders.	Number of cylinders.	H.P. of each engine.	Number of engines in service.	Transmission.	Number of speeds.	Maximum speed on the level m. p. h.	km./h.	Wheels pneumatic tyred.	elastic.	all-metal.	Average daily distance run, per railcar miles.	km.	Cost price, per mile run	Railcars reversible?	[illegible]
London Midland and Scottish Railway.																																					
[illegible]	[illegible]	3	3	...	...	Leyland	41′ 1″	12.52	10 1/2	10.6	40	...	...	10.7	1.00	...	2	1 at each end	1	Springless, special type	Vacuum and hand brake	Leyland	6	95	3	Mech.	2	56	90	...	...	Yes	1-ab 200 2- 180 3- 168	1-ab 321.8 2- 289.7 3- 270.4	...	Yes	Used on cross-country and [illegible] trailer. Built as twin coaches. A [illegible]
London and North Eastern Railway.																																					
	[illegible]	1	1	...	...	Armstrong Whitworth Co.	63′ 4″	19.30	42.5	43.18	60	...	1	46	4.27	1	2	»	1	buffer with oval shaped head and special steel spring «Bumper» type.	»	Armstrong Whitworth Co.	6	250	1	electr.	variable	56	90	...	...	»	185	297.7	[illegible]		[illegible]
	[illegible]	2	2	..	...	»	»	»	»	»	»	...	1	»	»	1	2	»	1		»	»	6	250	1	»	»	56	90	...	...	»	383	616.4			
[illegible]	[illegible]	1	1	...	...	»	53′ 0″	16.15	19.1	19.4	57	...	1	29	2.69	1/2	2	»	1		Westinghouse and hand brake	»	6	110	1	»	»	58	93.34	...	«Lang» type	...	268 259	430.2 416.8			[illegible]
South African Railways.																																					
[illegible]	[illegible]	1	...	...	1	S. A. R.	31′ 11″	9.73	21.3	21.64	30	...	1	37	3.43	1	1	at the front	2	none	hand brake	Hudson	6	91	2	mech.	3	35	56.3	...	...	6	88	141.6	11.12 d.		[illegible]
	[illegible]	1	...	...	1	»	38′ 0″	11.58	25.5	25.9	45	...	1	47	4.36	1.4	1	»	2	Standard S.A.R.	»	Leyland	6	80/100	1	»	4	40	64.37	...	...	6	...	..			[illegible]
	[illegible]	1	...	...	1	»	37′ 0″	11.27	26	26.4	32	...	1	57	5.29	1.7	1	»	2	none	»	Hudson	6	91	2	»	3	55	88.5	...	...	6	...	...			[illegible]
[illegible]	[illegible]	1	1	...	...	»	37′ 0″	»	26.5	26.9	60	...	...	...	...	...	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	70	112.65	[illegible]		[illegible]
[illegible]	[illegible]	2	2	...	...	»	37′ 0″	»	25.8	26.2	49	...	...	...	...	...	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	...	...		[illegible]	[illegible]
	[illegible]	3	..	...	3	»	37′ 0″	»	25.8	»	39	...	1	50	4.64	1.5	1	»	2	»	hand brake and compressed air	»	6	91	2	»	3	55	»	...	...	6	136	218.8	8.48 d.		[illegible]
	[illegible]	1	1	...	...	»	37′ 0″	»	29	29.45	49	...	...	...	...	...	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	86	138.4	17.58 d.		[illegible]
	[illegible]	2	.	...	2	»	37′ 0″	»	29	»	33	...	1	60	5.57	1.8	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	80 86	128.75 138.4	14.00 d. 8.67 d.		[illegible]
	[illegible]	1	...	...	1	»	37′ 0″	»	28.8	29.25	39	...	1	50	4.64	1.5	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	144	231.7	11.33 d.		[illegible]
		1	1	..	...	»	37′ 0″	»	29	29.45	49	...	...	...	...	...	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	107	172.2	16.49 d.	[illegible]	[illegible]
		1	...	...	1	»	37′ 0″	»	29	»	42	...	1	42	3.90	1.3	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	96	154.5	18.68 d.	[illegible]	[illegible]
		1	...	..	1	»	37′ 0″	»	28.7	29.16	40	...	1	34	3.15	1.0	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	114	183.5	14.13 d.	[illegible]	[illegible]
	[illegible]	1	...	...	1	»	37′ 0″	»	28.6	29.05	34	...	1	64	5.94	2.0	1	»	2	»	»	»	6	91	2	»	3	55	»	...	...	6	131	210.8	8.60 d.	[illegible]	[illegible]
	[illegible]	1	1	...	...	Drewry S. A. R.	60′ 0″	18.28	73.5	74.67	54	...	...	...	...	...	2	1 at each end	2	Standard S.A.R.	compressed air	Parsons	8	150	2	»	5	50	80.46	...	...	8			[illegible]	[illegible]	[illegible]
Great Indian Peninsula Railway.																																					
[illegible]	[illegible]	[illegible]	1	...	...	Armstrong Whitworth Co.	48′ 8 1/2″	14.84	16.2	16.46	58	...	...	...	...	...	2	»	1	central coupling	»	Armstrong Whitworth Co.	6	95	2	electr.	variable	40	64.37	...	...	8	172	277	[illegible]	[illegible]	[illegible]

Railcars or locotractors *(continued)*

Diesel, etc.	service	in service.	passenger.	goods.	mixed pass.-goods.	Name of builders.	Length over buffers. Ft.-in.	Length over buffers. Metres.	Weight empty. Engl. tons.	Weight empty. Metr. tons.	Passenger carrying capacity. Seated.	Passenger carrying capacity. Standing.	Goods compartments Number	Goods compartments Floor area. Sq. feet.	Goods compartments Floor area. M².	Goods compartments Loading capacity. Engl. tons.	Driver's cabins. Number.	Driver's cabins. Location.	Staff.	Buffing gear.	Brakes.	Engines Builders.	Engines Number of cylinders.	Engines H.P. of each engine.	Engines Number of engines in service.	Transmission.	Number of speeds.	Maximum speed on the level. m. p. h.	Maximum speed on the level. km./h.	Wheels pneumatic-tyred.	Wheels elastic.	Wheels all-metal.	A daily distance run per railcar. miles	A daily distance run per railcar.	Cost price, per mile (*)	[illegible]	Remark
County Donegal Railways.																																					
Petrol	1928	1	...	...	1	Local	22' 0"	6.70 m.	4.0	4.06	22	Not stated		In small special trailer.			...	...	1	Central coupling	Pedal and hand	Ford	4	35	...	Mech.	4	36	57.93	...	...	4	70	112.65	3.30 d. p. m.	Yes.	Can haul another motor vehicle or goods wagon (but ordinary coaches).
	1930	1			1	G.N.R. Works	30' 0"	9.14 »	6.0	6.09	30	»		»	»		...	...	1	»	»	Reo	6	35	...	»	4	36	»	...	...	6	125	201.15	3.50 »	»	Do.
Diesel	1931	1	...	...	1	»	32' 0"	9.75 »	7.0	7.11	30	»		»	»		...	...	1	»	vacuum and hand	Gardner	6	74	...	»	5	36	»	...	...	6	160	257.5	3.10 »	»	Can haul another motor vehicle or 1 or 2 goods wagons or an ordinary coach.
	1932	1	...	...	1	»	32' 0"	»	7.0	»	30	»		»	»		...	...	1	»	»	»	6	74	...	»	5	36	»	...	...	6	160	»	3.10 »	»	Do.
Petrol	1933	1	...	..	1	C. D. R. J. C.	22' 0"	6.70 m.	4.0	4.06	20	»		»	»		...	...	1	»	pedal and hand	Ford	4	35	...	»	4	36	»	...	...	4	75	120.7	3.30 »	»	Can haul another motor vehicle or one goods wagons (no ordinary coach).
							22' 0"	»	4.0	»	20	»		»	»		...	...	1	»	»	»	4	35	...	»	4	36	»	...	...	4	75	»	3.30 »	»	Do
»	»	1	...	...	1	»	28' 0"	8.53 m.	6.0	6.09	30	»		»	»		...	...	1	»	»	Reo	6	35	...	»	4	36	»	...	...	4	138	222	3.50 »	»	Do
»	»	1	...	...	1	Drewry Car Co.	28' 0"	»	6.0	»	30	»		»	»		...	...	1	»	hand	Baguley	4	35	...	»	4	36	»	...	...	8	120	193	3.50 »	»	Do.
Diesel	1934	1	...	...	1	Walker Bros & G. N. R.	44' 0"	13.41 m.	11.5	11.67	41	»		»	»		1	front	1	»	vacuum and hand	Gardner	6	74	...	»	5	36	»	...	...	8	160	257.5	3.10 »	»	Can haul another motor vehicle or 2 goods wagons or 1 passenger coach.
»	1935	1	...	...	1	Walker Bros & G. N. R.	44' 0"	»	»	»	41	»		»	»		1	»	1	»	»	»	6	74	...	»	5	36	»	...	...	8	160	»	3.10 »	»	Do.
	1936	1	...	...	1	»	44' 0"	»	»	»	41	»		»	»		1	»	1	»	»	»	6	74	...	»	5	36	»	...	...	8	Not yet in service.			»	Do.
	1933	1		Tractor.		C. D. R. J. C.	20' 0"	6.10 m.	11.0	11.17	...	...	...	...	...	...	1	driver's cabin	1	»	»	»	6	74	...	»	4	20	32.18	...	...	4	50	80.5	3.20 »	»	On the level can haul 10 ordinary loaded wagons at 15 miles (24 km.) an hour.
Great Northern Railway.																																					
Diesel	1932	1	1	...	...	G. N. R.	44' 0"	13.41 m.	19.0	19.3	50	...	...	...	...	...	2	1 at each end	1	standard 2 buff.	»	A. E. C.	6	100	1	»	5	45	72.42	...	...	standard	180	289.7	6.2 »	»	Mixed traffic.
							46' 0"	14.02 »	21.0	21.33	40	...	...	...	...	...	2	»	1	»	»	Gleniffer	6	120	1	electr.	...	45	»	...	...	»	200	321.8	7.5 »	»	Can haul 6-wheeled carriage. Mixed traffic.
	1934	1	1	...	...	»	50' 6"	15.39 »	14.75	15.0	50	...	...	...	...	..	1	front	1	central coupling	»	Gardner	6	96	1	mech.	5	45	»	...	...	»	230	370	4.2 »	no.	Used on secondary lines.
	1935	2	2	...	...	»	50' 6"	»	15.0	15.24	6 (I)-32 (II)-52 (III)-8 (III)	...	...	...	...	..	1	»	1	»	»	»	6	102	2	»	5	36	57.93	...	...	»	230	»	5.6 »	»	Two-coach set. Power vehicle alone in service. Only used in mixed-traffic shuttle service.
	1936	1	1	...	...	»	26' 7 1/2"	8.11 m.	7.0	7.11	28	...	...	...	...	...	1	»	1	...	pedal and hand	»	4	60	1	»	5	45	72.42	Howden & Meredith	...	...	170	273.6	3.6 »	»	Converted road bus. Used on main lines.
Petrol	1934	2	2	...	...	»	26' 0"	7.92 »	6.5	6.59	24	...	...	...	...	..	1	»	1	...	...	A. E. C.	6	90	2	»	5	45	»	»	...	...	150	241.4	4.9 »	»	Do.
Great Southern Railways (Ireland).																																					
Petrol	1927	1	1	...	...	Drewry Car Co.	23' 6"	7.20 m.	8.0	8.12	30	...	...	...	...	...	2	1 at each end	1	standard	»	...	4	70-75	...	»	3	38	61.15	...	...	yes	...	...	...	yes	5' 3" (1.600-m.) gauge.
		2	2	...	...	»	20' 6"	6.25 »	5.5	5.58	28	...	...	...	...	...	2	»	1	»	»	...	4	40	...	»	3	25	40.23	...	...	»	...	...	...	»	3' 0" (0.91-m.) »
Electric	»	2	2	...	...	G. S. R.	125' 8"	38.30 »	80.0	81.28	33 first 96 third	...	1	63.0	5.85	..	2	»	1	»	vacuum	British Thompson Houston Co.	2 engines	...	2	»	...	45	72.42	...	...	»	...	...	...	»	5' 3" (1.600-m.) »
Netherlands Railways.																																					
Petrol tractor	1927/1932	52	...	Netherlands Railways' design	...	Schwartzkopff, Berlin Werkspoor, Amsterdam	18' 11 9/16"	5.78 m.	11.6	11.8	...	...	...	...	...	...	3	2 outside in cabin	1	standard buffer	pedal and hand	Kämper, Berlin	4	50	52	mech.	4	...	30	...	...	yes	...	about 50	0.30 fl. p. km.	...	
Diesel tractor	1934/1935	53	...		...	Werkspoor, Amsterdam	23' 7 1/2"	7.22 m.	20.7	21.0	...	...	...	...	...	...	3	»	1	»	»	Stork, Hengelo	4	72	53	electr.	...	...	60	...	...	yes	...	»	»	...	
Petrol railcar	1923	3	yes	...	...	Linke Hofmann, Cologne	57' 8 1/2"	17.57 m.	33.5	34.0	sec. 25 3rd 40	10 10	...	...	...	...	2	ends	1	standard buffer	standard Westingh.	N. A. G.	6	75	6	mech.	...	...	70	...	...	yes	...	263	0.30 »	yes	Will be converted into diesel railcars.
do.	1924	10	..	.	yes	Werkspoor (5) Beynes (5)	58' 9 1/2"	17.92 m.	31.5	32.0	3rd 76	34	1	64.6	6.0	...	2	do.	1	do.	do.	N. A. G.	6	75	20	»	...	...	70	...	...	yes	...	239	0.30 »	yes	Do.
Diesel railcar	1926/1927	8	yes	...	...	(1) Hawa (1) Allan (6) Beynes	36' 11 11/16"	11.27 m.	18.2	18.5	3rd 43	24	...	...	...	...	2	do.	1	do.	do.	Frichs-Thomassen	6	115	8	»	...	...	70	...	...	yes	...	180	0.20 »	yes	New engines in 1935.
do.	1929	6	yes	...	...	Allan	36' 11 11/16"	11.27 m.	21.2	21.5	3rd 38	22	...	...	...	...	2	do.	1	do.	do.	Stork-Ganz	6	115	6	»	...	...	70	...	...	yes	...	181	0.20 »	yes	Do
Petrol railcar	1929	7	...	...	yes	Werkspoor	64' 4"	19.60 m.	44.3	45.0	sec. 16 3rd 49	8 9	1	56.0	5.2	...	2	do.	1	do.	do.	Deutsche Werke, Kiel	6	115	14	»	...	...	75	...	...	yes	...	273	0.30 »	yes	
Diesel triplet railcars	1934	10	..	...	yes	Werkspoor (25) Beynes (10) Allan (5)	206' 1/2"	62.80 m.	97.0	98.5	sec. 48 3rd 112	16 16	1	118.4	11.0	...	2	»	1	Scharfenberg Unirop autom	Knorr-Lambertsen brake.	Maybach (35) Stork-Ganz (5)	12 8	410 350	70 10	electr. »	.. ..	... ...	140 140	... ...	... ...	yes yes	... ...	550 550	(1) (1)	yes yes	(1) Cannot state exact figures at present.

(*) Including all charges, notably amortization and wages.

Railcars or locotractors *(concluded)*.

Table II [illegible].

[illegible]	[illegible]	[illegible]	[illegible]			Name of builders.	Length over buffers.		Weight empty.		Passenger carrying capacity.		Goods compartments.				Driver's cabins.		Staff.	Buffing gear.	Brakes.	Engines				Trans-mission.	Number of speeds.	Maximum speed on the level		Wheels			Average daily distance run, per railcar		Cost price, per mile (or per km. run (*)).	Are railcars reversible?	[illegible]
			[illegible]	goods.	mixed pass.-goods.		Ft in.	Metres.	Engl. tons.	Metr. tons.	Seated.	Standing.	Number.	Floor area. Sq. feet.	Floor area. M²	Loading capacity. Engl. tons.	Number.	Location.				Builders.	Number of cylinders.	H.P. of each engine.	Number of engines in service.			m. p. h.	km./h.	pneumatic [illegible]	elastic.	all-metal.	[illegible]	[illegible]			
Polish State Railways.																																					
Petrol	1931	1	1	...	. .	Austro-Daimler	73′ 10″	22.50 m.	18.5	18.8	56	...	...	...	...	...	2	...	2	Standard	Hydraulic	Austro-Daimler	6	80	2	Hydraul.	2	62.0	100	...	Yes	...	186	300	1.38 (0.86) zl.	Yes.	[illegible]
Diesel	1928/1934	12	12	...	...	Lilpop	41′ 4″- 43′ 7 5/8″	12.60- 13.30 m.	13.6-14.3	13.8-14.5	50	...	1	21.0	1.96	3.9 m³ 13.8 cu. ft	2	...	2	special	Westinghouse	Saurer, Ganz	6	100	12	mech.	4	44.7	72	...	...	Yes	279.6	450	0.82 (0.51) zl.	»	Mixed traffic.
»	»	8	8	...	...	5 = Cegielski 2 = Kiel 1 = [illegible]	60′ 1/2″- [illegible]	18.30- 22.20 m.	27.6-31.5	28.32	81	...	1	28.0	2.6	...	2	...	2	»	»	»	6-8	150	14	»	4	80.8	130	...	...	»	310	500	0.92 (0.57) zl.	»	Main lines.
Electric	»	[illegible]	[illegible]								.			...	..	..			..		.		...					37.3	60			»	[illegible]	[illegible]			[illegible]
Swedish State Railways.																																					
Diesel	1935	3	...	3	...	A.B.-Slipmateriel	24′ 7 1/4″	7.50 m.	17.3	18	...	...	...	...	...	...	1	Middle	1	standard	compressed air	Wisconsin Motor Corporation	6	150	1	mech.	5	31.0	50	...	...	yes	...	...	...	»	
»	1933/1935	15	...	15	...	Kalmar Verkstads A. B.	22′ 3 5/16″	6.80 »	17.3	18	...	...	...	...	...	...	1	»	1	»	»	A. B. Bolinder-Munktell	4	150	1	»	5	31.0	50	...	...	»	...	...	...	»	(1) 20 more units on order.
Petrol	»	13 (1)	13	...	...	H. Carlsson Mek. Verkst.	...	...	6.5	6.6	24	20	...	...	...	...	2	both ends	1	special	vacuum	A. B. Scandia-Vabis	6	100	1	»	4	50.0	80	...	yes	»	...	...	...	»	
Swedish Private Railways.																																					
Västergötland-Göteborg Railway.																																					
Petrol	1924	1	1	...	...	Kalmar Verkstad A. E. G., Berlin	35′ 2″	10.72 m.	12.8	13.0	30	...	...	...	...	...	2	both ends	1	central buffer of standard type	hand and compressed air	NAG, Berlin	6	70	1	pneumatic	...	31.0	50	...	...	yes	136.7	220	45 (28)	yes	
Petrol	1925	3	...	...	3	Deutsche Werke, Kiel	58′ 9 9/32″	17.90 m.	25.5	26.0	60 60 52	... ...	1 1 1	17.2 17.2 38.7	1.6 1.6 3.6	0.3 t. 0.3 t. 0.6 t.	2	»	1	»	»	Deutsche Werke, Kiel	6	150	1	»	...	37.3	60	...	...	»	134.2 134.2 151.0	216 216 243	69 (43)	»	
Petrol	1930	1	...	...	1	»	42′ 1 1/2″	12.84 m.	17.5	17.8	39	...	2	10.7	1.0	0.2 t.	2	»	1	»	»	NAG, Berlin	6	100	1	»	...	31.0	50	...	...	»	109.3	176	69 (43)	»	
Bergslagernas Railway.																																					
Petrol	1933	1	...	...	Yes	Nydqvist & Holm. Trollhättan	28′ 4 9/16″	8.65 m.	7.3	7.4	40	15	Post and lugg. inside 0.8 m² (8.6 sq. ft.) Lugg. outside 2 m² (21.4 sq. ft.)				...	...	1	front bumper bar	hand and vacuum	Maybach	6	90-105	1	mech.	...	25.0	40	...	yes	–	77.7	125	42 (26) (*)	[illegible]	(*) Not including amortization charges (first cost [illegible]) Swedish crowns.
Halmstad-Nässjö Railway.																																					
[illegible]	[illegible]	1	...	...	1	Deva (ASEA)	52′ 6″	16.00 m.	27.6	28.1	50	...	1	Luggage 50.6	4.7	1.5 t.	2	both ends	1	standard	hand and compressed air	Atlas-Diesel	6	75	1	electric	...	37.3	60	...	..	Yes	126.8	204	[illegible]	yes	
»	[illegible]	2					»	»	39.9	40.6	...	...	2	Luggage 152 Post 75	14.2 7.0	3.3 t.	2	»	1	»	»	»	8	160	1	»	...	37.3	60	...	...	»	162.8	262	»	[illegible]	
[illegible]	[illegible]	[illegible]					44′ 3 1/2″	13.50 m.	37.7	38.3	...	...	1	Luggage 152	14.2	2.0 t.	2	»	1	»	»	»	8	200	1	»	...	40.4	65	...	. .	»	243.6	392	.	»	
Hälsingborg-Hässleholm Railway.																																					
Petrol	1932	1	Locomotor	Locomotor	...		18′ 5 9/32″	5.62 m.	14.8	15	...	...	...	...	...	...	1	middle	1	standard	lever	Wisconsin	6	60-105	1	mech.	...	18.6	30	...	...	1	–			»	
	1926	1		.	1		25′ 5″	7.75 m.	5.2	5.28	25	...	1	10.7	1.0	0.2 t.	1	front	1	special	mech.	Ford	4	40	1	»	...	25.0	40	...	...	1	40.4	65	45 (28)	no	
»	1927 1928	2	..	..	1	...	33′ 6 3/4″	10.23 m.	14.2	14.4	36	...	1	10.7	1.0	0.3 t.	2	both ends	1	standard	»	»	4	25	2	»	..	37.5	60	..		1	49.7	80	64 (40)	yes	
» »	1930 1933	1 1	...	. .	1 1	... ...	33′ 6 3/4″ 49′ 7 9/32″	10.23 m. 15.12 m.	14.6 25.0	14.8 25.4	40 65	... ...	1 1	10.7 20.4	1.0 2.0	0.3 t. 2.0 t.	2 2	» »	1 1	» »	» compressed air	» Scandia Vabis	4 6	40 90	2 2	» »	... ...	37.3 46.6	60 75	... ...	... ...	1 1	77.7 201.3	125 324	45 (28) 47 (29) recent	» »	
»	1935	1	...	...	1	...	49′ 10 9/32″	15.20 m.	23.6	24.0	65	...	1	20.4	2.0	2.0 t.	2	»	1	»	»	»	6	110	2	»	...	56.0	90	...	...	1	146.6	236		»	
Diesel	1915	1	1	1	Post.	...	52′ 6″	16.00 m.	29.5	30.0	44	...	1	86	8.0	2.0 t.	2	»	1	»	»	Atlas Diesel	6	75	1	electric	...	37.3	60	...	...	1	201.3	324	40 (25)	»	(*) Including all charges, notably amortization and wages.
»	1919	1	...	1	»	...	45′ 11″	14.00 m.	34.4	34.9	...	...	1	118	11.0	2.5 t.	2	»	1	»	»	»	6	120	1	»	...	37.3	60	...	...	1	108.7	175	48 (30)	»	

sible to activate the traffic without any increase in staff expenses.

The *East Indian Railway* uses small steam locomotives hauling a very small number of coaches. Owing to the low price of coal, motor-vehicles have not been introduced. Three « Sentinel » steam railcars are however in use, their tractive effort being fairly low.

The *Dutch East Indies State Railways* only use, on secondary lines, locomotives withdrawn from service on the main lines.

The *Swedish State Railways* authorise, in certain given cases, the running of trains only staffed by a driver and a guard on lines where traffic is very light. In such cases the guard is bound to help the driver when the train is running on a clear line. Moreover, the regulator, the brake valve, the sanding gear device and the whistle must be so arranged that the locomotive can be controlled from both sides of the cab.

To a certain extent use is made of « Sentinel » steam railcars in place of ordinary steam trains on lines carrying light traffic. Nevertheless, these vehicles have proved to be insufficient on lines on which the traffic is more active; but as they are staffed by only two men, there is a certain saving on staff. (See Table I.)

On the *London & North Eastern Railway* only the shunting of goods wagons is carried out by diesel locomotives or tractors.

The *Swedish State Railways* use locotractors on a fairly large scale, mostly for shunting goods wagons at medium-sized stations, but also for hauling goods trains over short distances on lines with little traffic. They are driven by one man taken from the traffic department. Apart from the savings on staff, other advantages have become apparent : shorter stops of goods trains, improved service as regards delivery of goods wagons to users, etc.

There are numerous types of railcars. This method of transport appears to be rapidly developing. Railcars have often shown themselves very useful in retaining and increasing passenger traffic (see Table II).

The *County Donegal Railways* state that they have achieved their object when introducing railcars (in 1926), viz. reduction of train staff. Whereas a steam train means the use of four men, a railcar is only staffed by *one* man, who carries out all the duties. The cost per train-mile is also much lower: the railcar-mile only costs one fifth of the steam-train-mile. Maintenance expenses for railcars are appreciably lower. Railcars also made it possible to raise the average speed; in addition long and tiresome stops in stations are avoided. Light and inexpensive units enable more rapid and more numerous train connections.

Several railways state that they use railcars for supplementing regular passenger trains on certain lines or for, entirely or partly, replacing steam trains. The *Great Northern Railway* found that the running expenses of a railcar are on the average 5.75 pence lower than those for a steam train. No change in the average speed has been recorded. The *London Midland & Scottish Railway* states that the saving varies appreciably according to operating conditions and other circumstances, for instance, according to the trips made. Speed depends upon the operating conditions and condition of the track.

The *South Indian Railway* found a saving of 2.24 annas per train-mile as a result of using railcars, but there has been no increase in the average speed.

The *Great Indian Peninsula Railway* estimates the reduction in staff at one man and of the cost price at 1 rupee, 5 annas and 5 pice per train-mile. The average speed has been increased by 4 1/2 miles.

The *Danish State Railways* use locotractors and railcars requiring only one man (steam locomotives need two men). The train-speed has, as a rule, not been increased. The reason is that the legal requirements do not allow the speed to be increased on secondary lines that are not fenced-in, owing to the varying visibility near unguarded level crossings. The *Swedish State Railways* mostly use railcars driven by one man. This method has lowered the cost price per mile run by about 50 %. Certain short lines have been entirely motorised, the result being an appreciably increased average speed in certain instances.

On the *Deutsche Reichsbahn* it has been possible to reduce train staff to a minimum after fitting the compressed-air continuous brakes. According to the general regulations (in force on all lines), passenger trains having 12 axles at the most on lines having gradients below 1 in 200, goods trains having 30 axles at the most and inspection and breakdown trains are allowed to run without having any train staff on them. On the other hand, small « Reisezüge » (light trains), « Grossgüterwagenzüge » (bulk goods trains) and « Grossgüterwagenzüge » to which there are coupled ordinary wagons and having a total length of 300 m. (330 yards) at the most, as well as goods trains of ordinary wagons and having 60 axles at the most (and more after special permission is given), must be accompanied by one train-man. In the absence of any train staff, the driver also acts as guard. A fireman (or assistant) may be detailed to act as guard. The driver's cabin of railcars must, as a rule, be staffed by two men (driver and fireman or assistant). The guard may also perform the service of the assistant. On trains hauled by small locomotives (Kleinlokomotiven), and exceptionally on other trains, a one-man service is allowed. It has thus been possible to reduce cost prices to a considerable extent. Traction charges per train-km. amounted recently to 0.35 Rm. for railcars and 0.70 to 0.90 Rm. for light steam trains of a hauled weight of 80 to 100 tons.

The following table shows the percentage of the 22 900 km. of standard-gauge secondary lines run over at the maximum respective speeds indicated :

		1935	1927
		%	%
Up to 40 km.	*(25 miles)*	23.8	69.6
From 41 to 50 km.	*(26 to 31 miles)*	56.1	29.5
From 51 to 60 km.	*(32 to 37 miles)*	19.1	0.9
Above 60 km.	*(37 miles)*	1.0	...

QUESTION 5. — a) *State the aggregate length of secondary lines on which there are used the various traction methods described in your reply to the previous question (Question 4).*

b) *State, if possible, for each method the number of train-kilometres (or train-miles) run each day.*

c) *State the percentage which these figures represent in proportion to the total number of train-kilometres or train-miles run each day on your system.*

The table hereafter shows the use of the various means of traction described in the reply to question IV. Steam locomotives are only included in the table if they are of a particular type.

QUESTION 6. — a) *Is there, on your locomotives or rail motor cars which are driven by a single man, an appliance which automatically stops the vehicle in case anything happens to the driver, such as the « dead man's handle », for instance ?*

b) *If not, are you obliged to have on the train a second man who has access to the driver's cabin ?*

Steam locomotives and railcars are not fitted with appliances that automatically stop trains in case anything happens to the driver. The replies received do not mention any arrangements made for the purpose of making access to the driver's

RAILWAYS.	Push and Pull. (Klein-lokom.) Miles.	Sentinel. Miles.	Diesel locom. Loco-tractors. Miles.	Railcars. Miles.	Daily number of train-miles				Percentage of total number of train-miles.
					Push and Pull. (Klein-lokom.) Miles.	Sentinel. Miles.	Diesel locom. Loco-tractors. Miles.	Railcars. Miles.	
					(1)			(2)	(1) (2)
Deutsche Reichsbahn	...	...	...	...	88.2	...	...	...	0.044, 10
Danish State	...	...	...	401.4	...	...	...	3 612.7	13.6 approx.
London Midland and Scottish.	1 666	14	...	79	18 000	117	...	548	4
South African	...	...	...	1 026	...	...	...	...	...
Bombay, Baroda and Central India	...	...	...	...	...	184	...	...	...
Great Indian Peninsula	...	...	...	21.5	...	...	...	176	...
East Indian	...	689	...	...	...	3 586	...	...	0.04
South Indian	...	...	...	28.25	...	...	...	56.5	0.0014
County Donegal	...	...	...	110	...	...	...	922	75
Great Northern	...	...	...	78	...	...	...	500	5
Great Southern	...	...	...	40.5	...	...	...	230	0.5
Swedish State.	...	...	56.5	830.1	...	...	85.1	2 589.3	0.04

The *Netherlands Railways* supplied the following information.

Passenger traffic : Steam traction nearly everywhere.

Secondary lines : 977 km. (607 miles). Whole system 3 576 km. (2 222 miles).

Secondary lines : 2 × 7 trains daily. — Whole system : 2 × 17 trains daily. 12 % of total traffic on secondary lines.

Goods traffic. — Steam : 1 552 train-km. (964.3 train-miles), including 328 train-km. (203.8 train-miles) of optional runs.

Petrol and diesel tractors : 685 train-km. (425.6 train-miles) including 105 train-km. (65.2 train-miles) of optional runs. Steam : 4 % of total.

Petrol or diesel tractors : 35 % of total.

cab possible in case anything happens to him. In road service, the engines must as a rule be staffed by two men. Locomotives driven by only one man are only used for shunting.

Vehicles driven by internal-combustion engines, on the contrary, are fitted with an appliance of this kind, bringing the train automatically to a standstill. On some railways this device is obligatory if the driver is alone.

On the *Deutsche Reichsbahn* one-man driving is allowed under certain circumstances. In addition, the fitting of a safety device is required. In case of any break-down to this device, it must always be possible for a train-man to proceed to the driver's cab. To make one-man driving possible on secondary lines carrying little traffic, other attenuations may be introduced.

On the *Great Western Railway* diesel vehicles are driven by one man only, and a « dead-man's handle » does not exist. The driver constantly keeps his foot on the accelerating pedal, but even when that is not done the vehicle continues to run. There is, however, a guard on the car who can, in case of danger, work a lever which cuts off the feed and sets the continuous brake in action.

The *London Midland & Scottish Railway* only has Diesel vehicles (for shunting purposes) which are fitted with the « dead-man's handle ». However, shunting work is not allowed with a vehicle driven by one man : a staff of two men is obligatory. The guard of a train always has access to the driver's cabin of diesel vehicles.

The *London & North Eastern Railway* has had the « dead-man's handle » fitted to diesel vehicles, on which there are nevertheless two men.

The *North Western Railway* (India) has 6 motor vehicles manned by only one man. Only one of these vehicles is fitted with the « dead-man's handle ».

The *County Donegal Railways* report that their diesel vehicles have no stopping device of this kind and that they are all staffed by only one man, as there is no obligation to employ two men.

On the *Great Northern Railway* (Ireland), the motor vehicles are fitted with a pressure-reducing valve which the driver must open when running. When the valve closes the vehicle stops, but not by the action of the brakes. On the new vehicles this valve will be put into communication with the vacuum brake, in order to obtain braking by the « dead-man's handle ».

QUESTION 7. — a) *Have you made any alterations to passenger coaches or luggage vans running on secondary lines, in order to :*

b) *reduce the number of passenger classes or creating one single class ?*

c) *provide access, whilst the train is running, from the coach to the engine ?*

d) *reduce as much as possible the dead weight hauled ?*

It appears from the replies received that there are not many instances in which alterations have been made to passenger coaches for the purpose of reducing the number of classes or creating a single class. Motor vehicles as a rule have only one class, which has also had an effect on the number of classes on ordinary trains.

The *Great Western Railway* has had old coaches altered into trailers having only one class, for motorised traffic.

The *County Donegal Railways* mention that the 2nd class has been abolished on steam trains, the result being a reduction of one third in the weight of carriages. It is intended, later on, to do away with one more class, with a view to obtaining a certain similarity to motor vehicles.

On the *East Indian Railway* certain alterations have been made to passenger coaches with a view to having, on certain secondary lines, only two classes : « Upper » and « Lower », instead of four, viz. 1st, 2nd, Inter and 3rd.

On the *Great Indian Peninsula Railway* a single class has been introduced on certain lines.

The *Dutch East Indies State Railways* state that a single-class system is not in keeping with the nature and requirements of passenger traffic on secondary lines and that for this reason, on certain lines two-class rolling stock is used, and on others three-class vehicles.

On the *Polish State Railways* 1st-class has been abolished.

On none of the Railway systems consulted have arrangements been made to give access from trains or coaches to the locomotive. Except for what has been done on the County Donegal Railways, as mentioned above, there are no instances in which passenger coaches and wagons have been altered with a view to reducing the weight of trains.

On the *Deutsche Reichsbahn* no important alterations have been made to carriages in service, but it is planned to reduce the tare of coaches when new vehicles are built.

The *Danish State Railways* mention that the load of trains has sometimes been lessened by carrying goods otherwise than over secondary lines.

On the *County Donegal Railways*, as regards goods traffic, an attempt is being made to lower the weight of trains by forwarding wagons (loaded to full capacity) to transhipping stations. This system cannot however be carried too far, in order not to cause loss of time to consignees and avoid traffic, for this reason, going over to road-transport.

QUESTION 8. — a) *Do you attach trailers (passenger or goods) to railcars?*

b) *If so, how many and what are their characteristics ?*

c) *Is there any intercommunication between railcars and trailing passenger coaches ?*

It appears from the replies received that on various railway systems there are different methods, both as regards the haulage of passenger and goods rolling stock by motor vehicles and as regards providing inter-communication between a railcar and its trailers carrying passengers.

The *Deutsche Reichsbahn* allows one single carriage to be hauled when the tractive effort of a railcar, on account of the speed and gradients of a line, enables this to be done. Inter-communication between a railcar and its trailer does not exist unless the latter is fitted with multiple-control devices.

The *Danish State Railways* allow trailers of a maximum normal weight of 40 tons each being hauled. Most of the petrol vehicles have a low tractive effort and can only haul 30 tons at the most. Vehicles can eventually be run as twins and if the two motors are in action (driving staff of 2 men) they can haul a total weight of 55 tons. In the case of passenger-carrying trailers, inter-communication between them and the motor vehicle is provided.

On the *Great Western Railway* a train comprising up to 4 coaches may be hauled by a railcar, which gives the advantage of being able to vary the carrying capacity according to requirements. Diesel vehicles are not fitted with buffer gear or couplings and consequently cannot haul trailers. These vehicles have no exit at the ends.

On the *London Midland & Scottish Railway a single* « Sentinel » railcar may haul a 4-wheeled goods wagon.

On the *London & North Eastern Railway* a trailer, such as a passenger coach, a horse box or fish wagon, a luggage-van or a milk-van, when fitted with the continuous brake, can be hauled. No passage is provided between the motor vehicle and the vehicle trailed.

The *South African Railways* allow a light wagon to be trailed for carrying milk and cream, whilst in another case it is intended to use such a wagon for carrying other goods.

In addition, there are now under construction two large railcars — as a trial — which will be able to haul passenger coaches. Intercommunication will be provided.

The *Great Indian Peninsula Railway* allows one wagon to be hauled in case of need. There is no inter-communication.

On the *County Donegal Railways* passenger coaches or wagons may be coupled to railcars to cope with traffic peaks and to supplement steam train services. For passenger-traffic there is a light vehicle (of a weight of about 3 tons) having 32 seats and fitted with motor-bus seats and large windows giving a clear view on all sides. The smallest motor vehicles can haul one of these trailers. They are put into service on fair days, public holidays and other special occasions. Four of these trailers are in daily service. For the goods service, small open wagons are used, with removable tarpaulins, for carrying small packages; these wagons have the advantage of being able to be hauled by all motor vehicles. There are 18 vehicles of this kind in service. Weight : about 3 tons.

There is no communication between the motor vehicles and the trailers.

On the *Great Northern Railway* (Ireland) trailers are only coupled to a diesel-electric vehicle : to this vehicle an ordinary 6-wheeled passenger coach can be attached. There is no inter-communication between the railcar and the trailer.

On the *Great Southern Railways* (Ireland) vehicles of the « Drumm » and « Sentinel » types can, in case of need, haul one carriage. There is no inter-communication.

The *Polish State Railways* authorise the coupling of a single 4-wheeled passenger coach, with inter-communication.

On the *Swedish State Railways* one or two passenger coaches or two wagons may be coupled to large railcars. Inter-communication can be established and exists as a rule. Railcars of the small type can only haul one light trailer carrying luggage and express parcels. A trailer of this kind weighs 2 tons and its carrying capacity is 3 tons.

On the *private Swedish railways* two wagons of an ordinary type may be coupled; inter-communication is provided between the railcar and its trailers.

QUESTION 9. — *Do you impose any speed limit on railcars hauling one or more trailers ?*

According to the replies received no speed restriction is imposed on railcars hauling one or more trailers. Speed varies in this case according to the weight hauled and the gradients of the line.

The *Polish State Railways* point out, however, that a railcar hauling a trailer obviously can only run at a lower speed than that of a railcar running by itself.

On the *Swedish State Railways* the maximum speed of the rail motor buses is 70 km. (43.5 miles) *if the automatic brake of the trailer is coupled;* otherwise it is 50 km. (31 miles). The maximum speed for this kind of railcars, without a trailer, is 80 km. (50 miles).

QUESTION 10. — a) *On secondary lines do you work all traffic (passenger and goods) by means of railcars ?*

b) *If so, state all the chief characteristics of the district served (agricultural, industrial, etc.) and of the traffic handled.*

c) *What opinion have you formed, in view of results gained from experience, as to the advisability of using this method of working in the various cases that may arise, taking into account the importance and variety (peaks) of the traffic to be handled?*

d) *If there is only little goods traffic in full wagon loads to handle, is it possible to have wagons hauled by railcars without inconvenience?*

A few rare instances are reported in which the traffic (passengers and goods) is worked entirely by means of railcars.

On the *Danish State Railways* all the traffic is handled in railcars on a few lines carrying light traffic. Thanks to statistics showing the coefficient of use of trains and to information received from stations concerning all the circumstances that may affect the traffic, the latter can always be coped with. In case of need, steam trains can rapidly be put into service. Although there are, on all the other secondary lines, two steam trains a day, it appears that it would be possible, without any difficulty, to handle the whole traffic with railcars of sufficient power.

The *South African Railways* have a line 28 miles in length on which the normal traffic is, during 11 months of the year, handled by a railcar specially equipped, containing seats for 8 passengers, and which can carry 5 tons of goods. Originally this line was built to serve vast regions in which wheat was grown and on which steam trains are only run when the volume of traffic requires them. The supplementary trains on this line mostly carry wheat and cattle.

The *County Donegal Railways*. — On the Donegal-Ballyshannon line (16 miles) all the traffic is handled by diesel vehicles with very satisfactory results. All steam trains have been abolished. Goods traffic starting from this district consists of agricultural products, such as butter, eggs, potatoes, corn, cattle, and of ordinary goods; the incoming traffic consists of commodities. The 74-H.P. motor vehicles fitted with ordinary buffers do all the shunting and carry complete loads towards a junction station where they are picked up by steam train. The advantage of this method lies in savings as regards operation, one single train-man being needed instead of four on a steam train. This method, nevertheless, entails supplementary trips for the quick removal of wagons, but that is offset by the increasing receipts for passenger traffic due to higher train frequency. It is clearly difficult to adapt the running of motor vehicles to the volume and fluctuations in traffic, but these difficulties are counterbalanced by the considerable savings that can be effected.

The *Great Northern Railway* (Ireland) uses railcars exclusively for ordinary passenger traffic on secondary lines on which traffic is light. Railcars do not haul goods wagons.

The *Netherlands Railways* mention that trains on the Zwolle-Kempen line (13 km. = 8 miles, 1 100 passengers per diem) are made up as follows: railcar-wagon-railcar. In addition, there is one goods train on working days.

On the *Swedish State Railways* traffic is at present exclusively handled by railcars on two secondary lines, each 9 km. (5.6 miles) in length and serving agricultural districts. In the neighbourhood of the terminal stations there are, in addition, industrial and mining concerns. In addition to the farm products and articles for agriculture, the goods traffic consists above all of metallurgical products, timber, ore and ordinary goods. On a number of other secondary lines the traffic is not entirely motorised, but there is a tendency to replace steam trains by railcars and loco-tractors, especially on lines on which traffic is light. On several of these lines passenger traffic varies so very little that railcars would be able to meet all requirements in any case. If needed, steam trains can be put into service. On the *private Swedish railways* the entire traffic of only one line is handled by railcars. It is a case of an agricultural district with very little passenger traffic. Wagons can be hauled by the railcars without any inconvenience.

A general tendency is noticed, on certain railways, to use railcars whenever possible for hauling goods wagons, which are placed in the rear.

The *London & North Eastern Railway* points out that an additional wagon (passenger coach, horse-box, fish-van, parcels-van or milk-van) can in certain cases be hauled if it is fitted with the continuous brake. If it is not fitted with this brake, as frequently happens, trailing is not allowed.

QUESTION 11. — *What are the various advantages you have gained from using railcars on secondary lines ?*

a) *development or recovery of traffic as a result of the :*

— *increased number of runs owing to a reduced cost price per railcar-kilometre (or mile);*

— *increased average speed;*

— *increased number of stops so as to better serve localities situated along the line, etc.;*

b) *savings in working expenses, etc.*

The use of motor vehicles on secondary lines appears, on principle, to have shown the advantages anticipated, which has induced the Companies to continue their efforts in this direction. The advantages have been specially noticeable on lines where traffic is light and on which the need for economical operation makes itself particularly felt.

The *Deutsche Reichsbahn* has found that the greatest advantage obtained from the use of railcars consists in the reduction of operating costs (See *Question 4*). It is of opinion that, from the operating standpoint, it is of capital importance that when using railcars — either separately or with trailers — shunting should be avoided, as that means loss of time.

The *Danish State Railways* point out the quick acceleration power of railcars, the higher average speed obtained and finally the increased number of stops. In addition, railcars provide an advantageous working method owing to driving staff being reduced to only one man. Equally, these small train-units which are usually provided with a luggage compartment in the railcar itself enable the train service to be carried out by only one man.

For the *Great Western Railway* the principal advantage of railcars lies in the possibility of adapting the train service to local requirements. This Company has not found any appreciable difference between the average speed of railcars and that of light steam trains.

The *London & North Eastern Railway* points out that owing to the reduced cost of railcar operation it has been deemed advisable to substitute this traction method for steam on certain lines, and it has even been found possible to increase the frequency of runs, which was not possible with steam trains owing to the considerable expenses. Speeds, however, remain unaltered.

The *South African Railways* do not claim to frame any definite conclusions as regards the use of railcars, owing to the special nature of the districts served (thinly populated), and also because their experience has not been sufficient. In many instances daily services are required, although not really justified owing to the little amount of traffic. Nevertheless, this method of traction is considered to be of a nature to provide more scientific and cheaper operation. Speaking generally, the number of stops has not been increased as compared to that of ordinary trains on the same sections.

The *Great Indian Peninsula Railway* has noticed an increase in passenger traffic as the result of the introduction of railcars. The number of stops has, however, not been increased. The appreciable advantages of railcars consist in the fact that the necessity for having reserve engines has been avoided.

The County Donegal Railways point out that their railcars stop on request to allow passengers to enter or alight and consequently provide the same kind of service as motor omnibuses. This method meets competition from road transport, as passenger traffic has been recovered and developed. The public prefers railcars to motor omnibuses, owing to the safer and steadier running of the former. Thanks to the savings in working expenses it has been possible to increase the services by about 40 %. The new services have been much appreciated by the public. Journeys by mixed steam trains were long and tedious, due to lengthy stops in stations; railcar services have no such disadvantages, which makes it possible to offer an appreciably increased average speed to passengers. The saving in working costs is considerable. The operating expenses of a railcar are about one fifth those of a steam train.

The *Great Northern Railway* (Ireland) has also found that owing to the lower cost price of the railcar-mile it has been possible to create a more intensive traffic than was possible with steam trains. The possibility of allowing passengers to enter and alight at places which suit them has favoured the development of local traffic in the various districts. Nevertheless, these additional stops have prevented an increase in the average speed; it has, however, been possible to keep to the timetables. Employing 2 men (instead of 3 on steam trains) has made possible considerable savings on certain lines.

The *Netherlands Railways* find that railcars are cheaper to work than steam locomotives but that, even on secondary railways, railcars have not always proved adequate.

The *Polish State Railways* propose to stop railcars at level crossings on little used lines, where the distance between stations is considerable.

On the *Swedish State Railways* light railcars have above all proved useful for coping with passenger traffic on little used lines, but also to establish new long-distance connections. As these vehicles are staffed by only one man and as, in addition, the operating costs are low, it has been possible to increase the trips as well as the average speed. Halts of a simplified type, and unstaffed, have been established along lines served by railcars, which has helped to improve communications in the country. All these measures have had the result of appreciably increasing passenger traffic and in many cases it has been possible to regain from the roads all the traffic previously lost.

QUESTION 12. — *What are the drawbacks (difficulty of coping with traffic peaks, large reserve rolling stock required, etc.) you have met with in using railcars on secondary lines ?*

The replies received show that railcars, in spite of their low tractive effort, have been able to fulfil the task allotted to them on secondary lines. In several cases, however, it has been necessary to have recourse to steam trains during traffic peaks.

The *Deutsche Reichsbahn* points out that the restricted capacity of railcars when traffic suddenly increases is a great drawback, leading to complaints from passengers, and considerable expense and difficulties to the Company as the result of having to put steam trains into service in order to cope with the traffic.

The *Danish State Railways* stress the fact that the restricted capacity of railcars sometimes causes difficulties in this respect en route when unforeseen quantities of parcels traffic is offered. Steam locomotives have therefore to be kept in reserve permanently.

The *Great Western Railway* is of opinion that the difficulties as regards passenger traffic are, according to the experience gained, only slight. The maximum number of seats has proved sufficient to cope with « peaks ». In case of need, one or two vehicles are kept in reserve for certain services.

On the *London & North Eastern Railway* railcars have proved themselves capable of coping with ordinary traffic peaks. On days when there is increased traffic, such as on Saturdays, Bank holidays etc., the use of a trailer has proved sufficient. On special occasions only, railcars are withdrawn and replaced by steam trains. It has not been considered necessary to keep locomotives and carriages specially in reserve for this traffic.

The *London Midland & Scottish Railway* considers that the difficulties of coping with « peaks » are one of the reasons which prevent an extension of railcar services.

On the *South African Railways* it has also been necessary to run steam trains during « peak » periods. Advantage is taken of these periods for inspecting and overhauling the railcars.

The *Great Northern Railway* (Ireland) also mentions that railcars are unable on certain days to handle the traffic and are then replaced by steam trains. No difficulties have arisen owing to this fact, seeing that locomotives and carriages are always available at some centre near the secondary line whereon they are required.

The *Netherlands Railways* mention the drawback of having to house such rolling stock in a single central station.

The *Swedish State Railways* have found that when light railcars used on certain secondary lines are unable to trail ordinary vehicles, certain steps have to be taken for hauling goods wagons. Only in a few instances has it been necessary, in such an emergency, to replace steam locomotives by loco-tractors. On these lines, on which traffic can ordinarily be handled by light railcars, it sometimes happens that on special occasions, e. g. trips in connection with winter sports at Eastertide, the traffic increases to such an extent that the railcars intended in the first place for a local service, prove quite insufficient and have to be replaced by steam trains.

IV. — Safety measures applied.

QUESTION 13. — *Are all level crossings on secondary lines guarded ?*

Explain the various régimes to which level crossings are submitted.

In the case of unguarded level crossings, state how road users are warned of the approach of trains (audible or optical signals carried on trains, road signs, winking lights, etc.). Has visibility at level crossings been improved ?

The problem of guarding level crossings has partly been dealt with in *Question 11*. Referring readers to what has already been stated we will give below a brief summary of the regulations in force in this respect.

All crossings are not guarded on the *Deutsche Reichsbahn*. Visibility has been improved since 1930 in accordance with given rules. These rules, which differ according to the speed of road traffic, mainly concern the following :

From a given point on the road one must be able :

1. on perceiving a train, to stop the road vehicle in front of the warning cross;

2. to see at such a distance on the line that the time it takes a train to cover this distance gives the driver of a car, in case of need, sufficient time to get over the level crossing.

This point is generally 3 m. (10 ft.) for ordinary cars and 15 m. (50 ft.) for fast cars, from the warning cross, i. e. 8 m. (26 ft.) and 20 m. (66 ft.) respectively from the nearest rail. The distance of visibility is usually calculated according to the co-efficient 5 V for ordinary cars, and 3 V for fast cars (V representing the highest speed allowed for trains on this distance). If the distance of visibility is not sufficient in proportion to the maximum train speed on the line, this speed must be proportionately reduced.

The *Danish State Railways* use, at very busy crossings, barriers which can be worked on the spot or from a distance. As to unguarded crossings, two types may be considered : those having satisfactory visibility and those having poor visibility. At level crossings of the former type no warning signal is required except in case of bad weather, when locomotives must give an audible warning. As regards crossings of the second type, attempts are being made to improve visibility. If this is only partly possible, audible signals are required which, at dangerous crossings, are duplicated by warning signs for road users. These signals automatically show a red winking light on the approach of a train. After the train has passed, the light goes out. There is consequently no light when the passage is clear.

In *England* public level crossings are as a rule protected by barriers worked manually by a gate-keeper or a signalman, and by signs conforming with the regulations laid down by the Ministry of Transport. In certain particular cases exceptions are allowed in accordance with the working regulations for secondary railways. In some of these instances the crossings are open to road traffic, whilst cattle guards are sometimes used for preventing cattle from straying on to the line. The barriers are normally closed but in case of intense traffic permission may be given to leave barriers normally open to road traffic.

When gate-keepers are employed they are informed of the running of trains by means of disc appliances and, usually, by a bell repeating the signals exchanged between signal boxes on either side of the crossing. Barriers at accomodation crossings do not usually close in the line. They are worked by road users and are generally so built that their closed position is across the line. At certain places turnstiles have been provided for pedestrians. Such crossings are not protected by warning signals.

At unguarded crossings, which as a rule may not be public crossings, there are no protective devices. In a few cases, however, signs marked « Whistle » have been placed at a sufficient distance from the crossing. Drivers are then bound to sound their whistles. At certain crossings alarm bells connected to rail contacts have been installed, whilst at others there are signboards « Beware of the trains » or bearing some similar inscription.

The barriers at public crossings are usually painted white and are fitted with red discs. In addition, on each side of the crossing, lanterns are used, showing a red light towards the road when trains pass. There are also at certain places cat's eye reflectors with the word « Stop »; these are placed on a level with the headlights of motor cars.

The *Kenya & Uganda Railways* state that only in a few urban areas are level crossings guarded, although warning signboards are always erected.

On the *South African Railways* all crossings are unguarded but cattle-guards are installed in case of need. At these unguarded level crossings signposts marked « Whistle » are erected 400 m. (440 yds.) from the crossing on both sides. At this spot the engine driver whistles several times and, in addition, gives a prolonged blast at 125 yards from the crossing. On the road « X » shaped warning signs are placed at 300 ft. from the crossing, as well as « Stop » signboards close to the crossing.

On the *Bombay, Baroda & Central India Railway,* barriers at crossings are either interlocked with the signals in such a manner that they cannot be opened before the signals are « on » or else they are supervised by a gate-keeper who closes them when he perceives a train or after receiving a warning from the alarm-bell. There are also crossings that have no barriers and that are unguarded.

The *North Western Railway* (India) subdivides level crossings into catagories as follows :

a) « Special », where there is intense traffic both on the road and on the railway, necessitating special safety measures, e. g. in towns and in their suburbs;

b) Category « A » over main roads;

c) Category « B » over macadamised or gravel roads which are not main roads;

d) Category « C » over non-macadamised and village roads;

e) Category « D » over small paths and agricultural crossings.

Crossings in « C » and « D » categories are not guarded, nor are they provided with barriers nor chains. At unguarded crossings, road users are warned by signboards.

On the *County Donegal Railways* all crossings are guarded and provided with barriers. The barriers normally close the railway track and leave a clear passage for road users when no trains are passing. There are in all 62 level crossings on this railway system. All the barriers are fitted with red discs and, at night, a lantern shows a red light and a green light which are visible both from the road and from the railway. In cases of poor visibility (24 cases) a distant signal is used, connected to the barriers, to warn train drivers. When a crossing is not clear (on the approach of a train), road users are warned during the daytime by a red disc and at night by a red light. The local road authorities usually install signboards on roads to indicate level crossings; there are no obligations on the railway in this respect.

On the *Netherlands Railways,* as a rule, level crossings are not guarded except in cases where the State Supervising Office considers it necessary.

No warning is given to road users, when a train is approaching. As a trial, a level crossing has been equipped with winking lights installed on the road.

On the *Dutch East Indies State Railways* little used crossings are not guarded. A few unguarded level crossings are not provided with barriers and are indicated as follows :

— on the road by mere signboards informing the public that a level crossing is nearby;

— on the railway line by signposts warning train drivers of the nearness of an unguarded level crossing and ordering them to give audible warnings to road users.

Other unguarded level crossings are provided with barriers worked from a distance, which are closed after an audible warning emitted by a bell at a central control box.

On the *Polish State Railways* level crossings are subject to the same regulations as those on main lines, except for certain allowances. Users of unguarded level crossings are informed of the approach of a train by audible signals given by the driver of a train. At a certain number of level crossings, luminous and audible signals have been installed.

The *Swedish State Railways* are bound by a Government decree to place warning signs at public crossings (in the shape of crosses and, in addition, where there is not a clear view, to take special safety precautions, such as :

a) barriers to be guarded and closed when trains pass;

b) luminous signals showing, day and night, a winking red light on the approach of trains, and a white light when the road is clear;

c) alarm-bell worked by approaching trains.

The luminous and audible appliances are automatic, viz. set in action by the trains.

Visibility of the line on both sides of a level crossing is considered satisfactory when road users, being a distance of 25 m. (80 ft.) from the nearest rail, can, both by day and night, perceive a train when it is at a distance from the crossing equivalent to 6 times the maximum speed allowed on the line, expressed in metres.

When making a choice of these various safety devices, it should be borne in mind :

that barriers are to be used at level crossings situated near a station where there is much shunting, as also at crossings that have a great deal of traffic passing over several tracks, or at crossings situated within or near populous localities;

that luminous signals can be used in other cases and that alarm-bells alone are only admissible on roads that are not much used and on which motor traffic is nil or at any rate very light.

Barriers are painted red and yellow alternately.

* * *

As regards visibility at level crossings, it appears that there are no prescriptions for improving it, but efforts are nevertheless made to do this by the felling of trees, by earthworks, etc.

The *Dutch East Indies State Railways* declare that if visibility at level crossings is not sufficient it is improved by clearing part of the adjacent land of all vegetation and of other obstacles as follows :

Maximum hourly train speed allowed.	Extent to which land adjacent to level crossings is cleared.	
	Along the road.	Along the secondary railway line.
60 km. (*37.3 miles*).	30 m. (*100'*)	400 m. (*1 300'*)
50 km. (*31.0 miles*).	25 m. (*82'*)	300 m. (*1 000'*)
45 km. (*28.0 miles*).	20 m. (*66'*)	200 m. (*650'*)

QUESTION 14. — *On your secondary lines, have you level-crossing barriers that are worked automatically? If so, describe the system briefly.*

There are no instances known.

QUESTION 15. — a) *Have you any double-track secondary lines?*

b) *Have you substituted, on your secondary lines, a simplified signalling for the normal signalling as used on main lines?*

c) *If so, do you use signals for the protection of stations, to ensure the correct headway between trains and,* on single-track lines, *for the crossing and overtaking of trains?*

d) *If you use signals of a special type, give a description of them, with particulars as to their location.*

Double-track secondary lines only exist, more or less, on the Railway systems in England and in Germany. The general principles governing signalling on secondary lines are the same as those for main lines. Beyond these two countries, it does not seem that any double-track secondary lines have been built.

As regards signalling on secondary lines, in several instances there has been introduced simplified signalling, as compared to signalling enforced on main lines. This point has already partly been dealt with in *Question 2*. We give below a few additional points of view that are of interest.

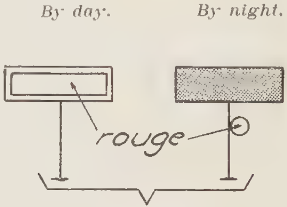


Fig. Ve 1

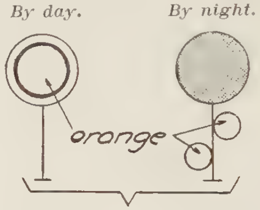
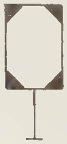


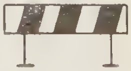
Fig. Ve 2

Rouge = red.

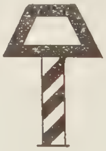
On the *Deutsche Reichsbahn,* at crossing stations use can be made, in place of a stop-signal, of a disc signal for the protection of train (fig. Ve 1), in front of which signal trains must stop. This signal can be preceded by a distant disc (fig. Ve 2), which corresponds to the ordinary advanced signal of a stop signal. When in the « line clear » position, the discs of the two signals are turned at 90° and the lanterns show white lights. On secondary lines the location of advanced signals, distant discs, slow-down indicators and detonators must correspond to a braking distance of 400 m. (440 yds) and, in particular instances, of 700 m. (770 yds) instead of 700 m. and 1 000 m. (770 and 1 100 yds) respectively on main lines. Use can also be made of a simplified tail light on trains, i. e. a single signal showing a red light towards the rear. No signal preceding the advanced home signals is in use on secondary lines. In case of need a special post (fig. K6) is installed, from whence onwards slowing down is compulsory. A stopping place which, owing to local conditions, is difficult to see, is shown to drivers by a special marker board (fig. K9). In front of stations not fitted with home signals, the point where trains have to stop can also be denoted by a special marker post (fig. K15). In addition, when the advanced signal or the disc signal protecting trains is lacking, a special signpost (fig. K16) can be placed at the braking distance from the stop signal or the signal protecting trains. All signals and marker posts are placed on the right-hand side of the line.



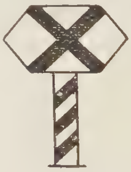
K6



K9



K15



K16

On the *Danish State Railways* the same system of signalling is applied on secondary lines as on main lines, with the exception that advanced signals are not obligatory on secondary lines unless the stop signal is difficult to see.

On the *South African Railways* stop signals are not used unless the need for same is felt. Use is also made of approach signboards which are placed 2 400 feet from facing points, and which protect trains beyond that limit.

On the *Dutch East Indies State Railways* the signalling used for crossing and overtaking of trains on secondary lines on which the maximum speed of trains is over 30 km. (18.6 miles) does not differ from what is in force on main lines, whereas on secondary lines on which the maximum speed allowed is equal to or less than 30 km. protection signals at stations are not obligatory and may be replaced by simple signposts.

On the *Polish State Railways* a simplified system of signalling is also in use. As home signals or open-track signals, the use is allowed of distant discs, i. e. round or square red discs with are placed at a distance of 300 to 800 m. (330 to 880 yards) in advance of the point to be protected.

With a view to accelerate trains, the *Swedish State Railways* make use of signals at stations where crossing or overtaking is allowed for in the timetables. It is nevertheless allowed, in case of need, to remove the crossing or overtaking to a station not fitted with signals, if the prescribed safety measures are complied with.

Distant signals may be replaced by so-called « orientation » signposts. They consist of three non-coloured reflector prisms arranged in triangular form, which reflect the lights of locomotives.

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Signals of a special type are not generally used. On the *Swedish State Railways,* however, the system of signalling illustrated in table III is used. The leading-in points are fitted with a centering spring which forces them back to their normal position after they are passed. The points are so arranged that they lead, in their normal position, to different tracks. They are, in addition, connected to the home signals which protect the place in such a manner that the opening of one or the other of the home signals is prevented if the two sets of leading-in points are not either in the normal or in the opposite position. In case of crossing, the train which arrives first — in case of simultaneous arrival, the even-number train — can enter without stopping in front of the entry points, but the driver must whistle several times to inform the guard of the other train. The second train is then authorised to enter after a shunting signal has been given by the guard of the first train. In case of overtaking, the train which has arrived first enters the station and advances beyond the end points to back on to the other track, which avoids the intervention of station staff.

QUESTION 16. — *When you have eliminated signals protecting stations or replaced signals of the normal type by simple marker posts, what are the speed limits imposed on trains entering stations, when crossing another train?*

From the replies received it appears that only in a few instances has a speed limit been ordered for trains entering stations when signals have been suppressed or replaced by mere marker posts, notably in case of crossing.

The *Deutsche Reichsbahn* states that on secondary lines on which simplified operation is in use a train may enter an unstaffed block section or a block section not fitted with signals for protecting trains if no crossing is to take place. In other cases, it may only enter after having stopped and the route been checked by the guard. Trailing points may not be run over at a higher speed than 20 km. (12.4 miles). In case train succession is simply governed by spacing between block sections, the train that follows may only enter a station not fitted with protection signals at a maximum speed of 20 km. (12.4 miles) and, in case of poor visibility, at a speed of 10 km. (6.2 miles).

On the *South African Railways,* where stop signals are only installed in case of need, the maximum speed is 20 miles at the entrance to a main track and 10 miles at the entry to a turnout, in such cases.

The *Bombay, Baroda & Central India Railway* states that on secondary lines a speed limit (10 miles per hour) is imposed on trains running through stations having simplified signalling.

On the *Great Indian Peninsula Railway* trains enter stations, in which all the points and signals are locked, at the maximum speed allowed on the line. When crossing unlocked points, the maximum speed may not exceed 10 miles. In cases of trains crossing, there are no speed restrictions.

On the *County Donegal Railways* (Ireland), crossing trains may not enter stations at a speed of over 6 miles.

The *Dutch East Indies State Railways* oblige their drivers, in case of crossing, to stop in front of the first points encountered before entering a station.

On the *Swedish State Railways,* at the entrance to stations having no home signals, the speed may not exceed 40 km. (25 miles); in case of need it may be still further restricted. Crossing trains must stop in front of the first leading-in points. If a train which has arrived first has entered a station and stopped in same, the second train is not obliged to stop and may enter straight away upon receipt of a shunting signal given by the guard of the first train, who is responsible for the route of entry of the other train. The first train is obliged, upon entering the station, to warn the staff of the other train by a blast on the whistle. At the entrance to stations provided with stop signals, but at which the points are not locked, the maximum speed is 40 km. (25 miles) over points and turnouts.

QUESTION 17. — *Have you found it necessary to protect trains stopped on an open line ? When this precaution is not obligatory, how is safety ensured ?*

On most of the Railway systems consulted, all trains at a standstill on the open line must be duly protected both in front and in the rear. As a rule no exception is allowed safe in a few rare cases.

On the *Deutsche Reichsbahn* the same rules are applied in this case on all lines except that it is not necessary to cover trains on an open line unless the maximum train speed exceeds 60 km. (37.3 miles). Supplementary measures are not considered necessary.

On the *Great Western Railway,* on double-track lines, trains are protected by the guard who carries a red hand-signal and lays three detonators at a distance of 3/4 of a mile from the tail end of the train. A similar protection must be provided by guards on lines on which trains are worked on the train-staff system, when the driver is in possession of a « ticket ». Contrariwise, this system of protection is not required on single lines when the driver carries a train-staff or is accompanied by a pilot, which is a guarantee against the approach of another train.

The *County Donegal Railways* (Ireland) consider that protective measures are not necessary when the running of trains is regulated by the electric train-staff system, which prevents the presence of a second train on the same block section. If, in such a case, the train is stopped for some time, the driver or guard are obliged to lay detonators in the rear to protect the train. This is always obligatory when an accident has happened, even if the driver carries the train-staff.

Swedish State Railways. — When a train stops on the open line for any reason but will be able to proceed as far as the following station within 15 minutes after the time fixed for running through the section, it is not considered necessary to take protective measures. Within this lapse of time it is considered that there is no danger from a safety stand-point, owing to the time allowed for entering a block section.

If, however, it is considered that the train cannot be brought to the following station within the time stipulated, safety measures are to be taken, which consist in laying, in front of and behind the train, 4 detonators at a distance of about 800 m. (880 yds); in addition, if there is sufficient time, a red disc, or at night-time a lantern showing a red light, is placed on a level with the detonator furthest away. The detonators are placed at an interval of 20 m. (66 ft.). In addition to these measures, a man must be detailed to keep a watch over the signals.

For a train obliged to stop in front of a station before being allowed to enter it there are special safety regulations. In case a train brought to a standstill on the open line cannot continue its journey and has to run backwards, a signalman must walk ahead of the train at a distance of 600 m. (660 yds), giving stop signals. At the same time the driver must give repeated whistle blasts. If the train can only take part of the rake, the other part must be protected, but only in the rear and in the manner described above.

QUESTION 18. — *May certain signals be left unlighted at night? If so, must they be fitted with cat's eye reflectors? Must trains carry more powerful headlights than the usual lanterns?*

According to the information received, all signals, without exception, are so designed that they can, in case of need, be lighted at night. On the other hand, they are naturally not lighted at night during the hours when traffic is interrupted or when a signal box is not in service, etc.

There are no regulations ordering the use of cat's eye reflectors on unlighted signals.

On the *Great Western Railway* use is made, with a view to reducing maintenance costs, of lanterns that can burn a whole week without being attended to.

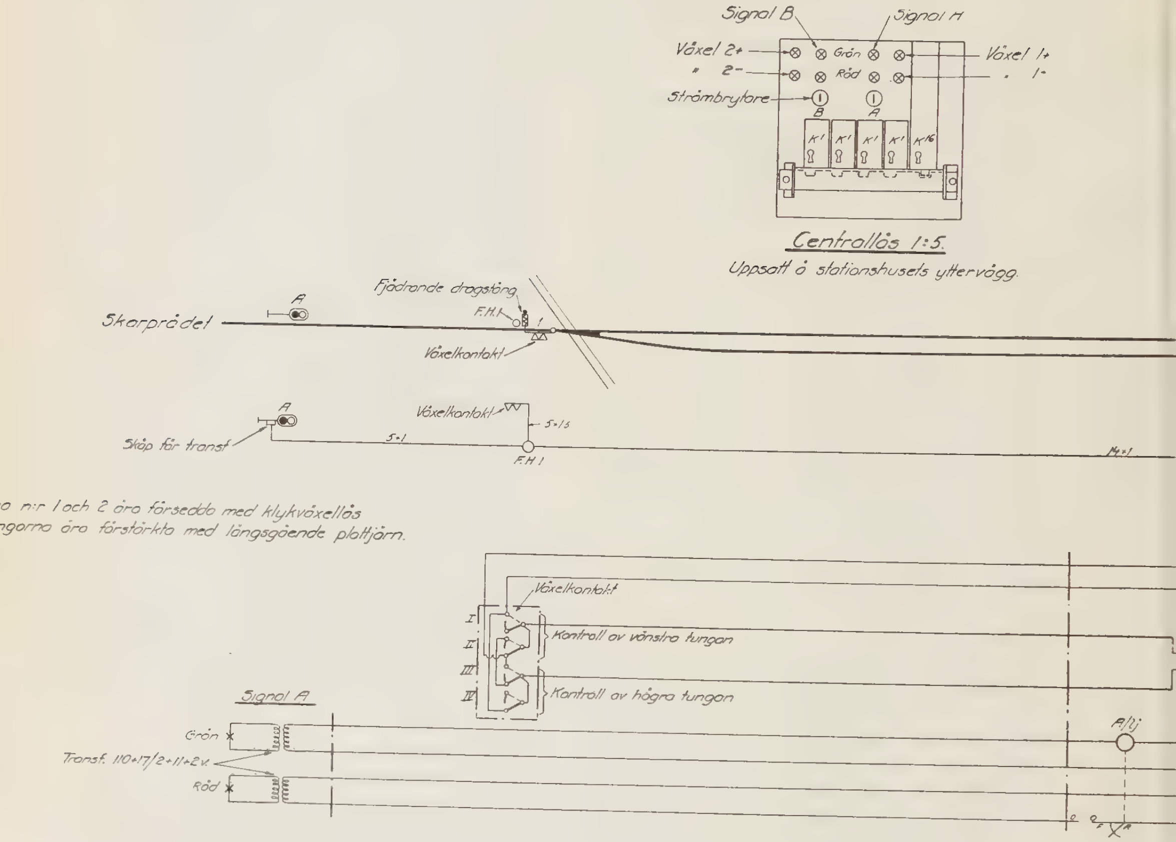
On the *Swedish State Railways* signals fitted with cat's eye reflectors are not used except for so-called « orientation » signposts and, in particular instances, for « Passengers alight » signs. The former resemble those used on roads for automobile traffic and consist of three plain-glass reflective prisms arranged in triangular form and reflecting locomotive head lights. The latter consist of a pole bearing a round revolving disc painted yellow, with a black edging. The disc is fitted with a lantern giving a yellow light by night or with a yellow reflective prism reflecting locomotive headlights. The lantern may also be of a kind that emits a yellow light day and night.

It does not appear that any measures have been taken for increasing the power of locomotive headlights, which are of standard type on all lines. But on electrically lighted railcars, the headlights are usually very powerful, which has proved advantageous from several points of view.

The *East Indian Railway* proposes to fit powerful headlights to all its locomotives used in passenger traffic.

The *Dutch East Indies State Railways* require the headlights carried on the front of trains to be more powerful than the lanterns usually employed.

QUESTION 19. — *Have you made any changes in the arrangement of points and crossings, in the working of same*



Explanation

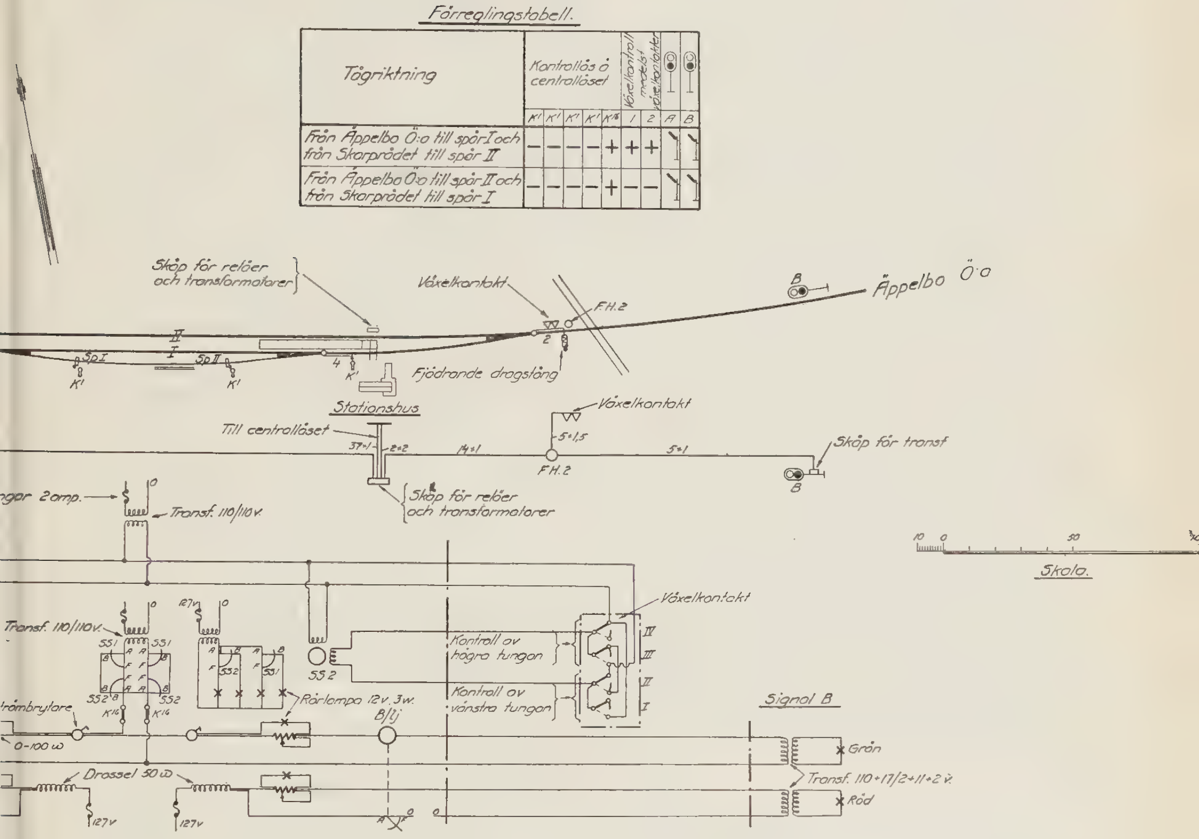
Centrallås... = central locking frame fixed to station wall. — Fjädrande dragstång = centering spring. — Växel = points. — Växelkontakt = point contactor. — Växlarna n : r 1 och 2 äro försedda med klykväxellås = points nos. 1 and 2 are fitted with a lock. — Växeltungorna äro förstärktamed längsgående plattjärn = point tongues are reinforced longitudinally by flat iron. — Grön = green. — Röd = red. — Kontroll av vänstra tungan = control of left-hand point tongue. — Kontroll av högra tungan = control

as well as that of signals which can give at least two indications?

Do you apply, in certain case on secondary lines, an economical system of distant working of points and signals? Please give a description of same.

The replies received to this question are as a rule negative, seeing that the methods used are the same as on main lines.

The *London & North Eastern Railway* mentions that on the *light railways* a device is used for locking facing points, which makes it possible to work the



edish terms:

of right-hand point tongue. — *Förreglingstabell* = locking board — Tågriktning = running direction. — Från Äppelbo Ö: a till spår I och från Skarpradet till spår II = from Äppelbo Ö to track No. 1, and from Skårpradet to track No. 2. — Skåp för reläer och transformatorer = locker containing relays and transformers. — Stationshus = station building. — Kontrollås å centrallåset = control locks at central locking frame. — Växelkontroll medelst växelkontakter = point control by means of point contactors.

locks and lock rods — if there are any — by means of a lever. Lock rods are not considered necessary when the point lever is alongside the latter.

The *Swedish State Railways* use — as a trial in a few rare instances — points having a centering spring which, after trailing, resume their normal position. The arrangement of the spring resembles American practice but is modified to adapt itself to the Swedish types of points.

No railway makes any mention of applying an economic system of distant control of points and signals on secondary lines.

QUESTION 20. — *How is the running of trains on secondary lines regulated?*

Is there a control-station (one single station that is responsible for all movements on a section and which decides changes in the order of running of trains on a single track, changes of crossing places, the running of optional trains, etc.)?

In that case, has the staff of intermediate stations to share in the carrying out of regulations concerning the safety and running of trains?

What are, in this respect, the duties of guards?

Can the latter communicate with the control-station?

Have you organised real train dispatching on secondary lines? If so, what are the technical means used for carrying that out economically?

Does the dispatcher play any part in the shunting in stations?

Give a brief description of the dispatching system you have introduced and state whether such system enables the management of stations to be handed over to persons other than railway officials.

Several very varying methods are in use for regulating the running of trains on secondary lines. As a rule, printed timetables are used, at any rate for passenger trains, as a basis for their running. All train crossing places are usually indicated in these timetables.

The *Deutsche Reichsbahn* has given detailed replies on this subject, especially as regards secondary lines having simplified operation. In particular, on lines on which there run 20 trains or over per day (40 on double-track lines), a traffic-regulating station is provided for one or more sections comprising several signal boxes. At these stations there is a traffic controller (dispatcher) who takes all the requisite steps concerning running on the section. Only the important signal boxes are manned by a traffic employee, all the others being considered as « unstaffed », in spite of the presence of a certain personnel, such as « agents » dealing with traffic operations. The traffic employee in a « staffed » station, works the points, sends off the trains, etc., these duties being performed by the guard in « unstaffed » stations.

On a regulator-section trains can only run, as a rule, at double intervals towards unstaffed stations and at single intervals towards stations that are staffed and protected by signals. Exceptions may be allowed in certain particular cases. It should be especially borne in mind that trains, in conformity with an authorisation from the competent Minister, may run « at sight » (except in cases of bad visibility). In such cases the speed must be so modified that the braking distance is equal to half the distance in sight. The regulator gives permission to start in accordance with the special regulations in force.

The signalling-in of trains between two regulator-stations is usually done by telegraph but it may, in certain particular cases, be simplified; the telephone may be used to a certain extent. All boxes regulating the succession of trains are, among other things, in telephonic communication with the regulator. In an unstaffed station a train carrying no guard cannot cross another train unless the latter carries a guard. On a train having no guard the driver acts as a guard; the fireman is not allowed to perform this duty but he may be detailed to assist in shunting operations, loading and unloading goods, etc.. Male station employees may, in certain circumstances, be required to carry out duties in connection with the train working e.g. transmitting orders and communications between the regulator and the guard, giving signals to men on the road for the purpose of preventing some danger or other, etc.

The regulator orders all crossings and overtakings but is not responsible for shunting in stations. The responsibility for that is assumed by the traffic official or by the guard.

On the *English Railways* the running of trains on secondary lines is, to a fairly large extent, regulated by technical appliances such as telephone or block apparatus. Bells, electric train-staffs with or without tickets, « one engine under steam » are other systems. On double lines the absolute block system is generally in force.

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The system of one control-station, from which the running of the trains over a whole section is regulated, is not very widespread. In certain particular cases, e.g. as regards goods traffic, the regulating is done from certain service-centres. In that case a telephonic line is provided between stations for control purposes when circumstances require it.

Bombay, Baroda & Central India Railway. — On important secondary lines regulating is done by special « train controllers » who deal with the operation of special trains and optional goods trains, whereas the daily passenger trains run to schedule. On other secondary lines the traffic is regulated by printed timetables in which crossing places are indicated. The running of goods trains is decided by station masters of the terminal stations, the latter serving as control-stations. Train crossings are regulated by station masters of neighbouring stations.

A similar organisation also exists on other Indian railways.

On the *North Western Railway and the East Indian Railway* the train succession on secondary lines is regulated according to one or the other of the following systems : absolute block or « one engine under steam ». On the East Indian Railway the train schedule is, on a few lines, subjected to the control of a central controlling office. In these cases the personnel at intermediate stations is bound to assist in regulating the running of trains.

The *County Donegal Railways* (Ireland) report that optional trains cannot be put into service except with permission from the « director ». The whole traffic system is controlled by electric train-staff. In case a train is late the heads of the regulator-places have the right to order changes of crossings to the extent which the regulations concerning piloting allow it. But this cannot take place unless the « director » is informed of same, the latter being in a better position to judge as to what measures should be taken, by taking into account all the circumstances referring to the operations in question.

On the *Dutch East Indies State Railways* the running of trains is regulated by the timetables and corresponding graphs. The secondary lines are divided into sections bounded at each end by control stations which draw up by joint agreement (by telephone or telegraph) details of train schedules on the section in question as regards crossings, overtakings, etc.

The *Polish State Railways* propose to regulate the running of trains on lines carrying light traffic by a « sectional controller ». In this case the running of the trains, based on the reports of the guards and traffic requirements for a given section, will be concentrated at a sectional station called a « regulator-station ».

On the secondary lines of the *Swedish State Railways* the traffic is regulated by timetables and graphs in which all the trains appear. The regulator orders optional trains and cancels certain trains as required. In Sweden the regulating of trains has always been centralised. Trains despatched from one station to another are signalled in and back by telephone. There are no stations that regulate train succession.

⁂

As regards the obligation of the staff at intermediate stations to take part in carrying out prescriptions concerning the safety and running (movement) of trains (regulated by a control-station), the *Great Western Railway* states that the staff at all stations is bound to carry out all safety measures required for protecting the trains. If a train is stopped beyond the time fixed, in a station at which the signal box is not manned and where the signals are kept normally at « line clear », the personnel must put the signals in the « stop » position for the protection of the said train. The train guard has to take steps to protect the train, except on single-track lines when the driver carries a train-staff or ticket of else is accompanied by a pilot. He does not intervene otherwise in changes of train schedules.

On the *South African Railways* intermediate stations deal with train control in both directions, train-guards being relieved from such duty.

On the *Great Indian Peninsula Railway* intermediate stations are bound to take steps with a view to ensuring safety. They are also obliged to follow up the normal running by regulating crossings of trains in stations. In case of need the guards can get into touch with the traffic controller, if there is one, by telephone or by telegraph.

On the *South African Railways* the train running orders are fixed in advance. The « Train Ordering Official » orders auxiliary trains of which the running is as a rule communicated in time to all station masters.

The *County Donegal Railways* state that a single guard accompanies the train and that he is under the orders of station masters, who decide any required changes in working. The same applies to the *Great Northern Railway* (Ireland).

On the *Dutch East Indies State Railways*, in case anything happens on the open line, the guards of trains inform neighbouring stations by telephone or by any other means.

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A real dispatching system does not appear to exist on the secondary lines of the Railway Systems consulted.

The *East Indian Railway* mentions, however, the organisation of dispatching in certain particular instances, without describing same. But this system is not extended to shunting in stations.

The *Polish State Railways* are now studying the question.

The *Swedish State Railways* have always applied the system of central train control, except on lines handling ore, where decentralisation is practised because the traffic consists essentially of loads of ore and of empty wagons, i.e. a special and uniform traffic.

Central regulation is carried out on the same principles as dispatching. In both instances train control over a section is entrusted to a special official : the controller or dispatcher. He constantly follows up the movement of trains from a central office where he has the requisite technical means at hand and takes the necessary steps for maintaining or re-establishing regular traffic. In addition to dispatching operations properly speaking the controller also deals with factors which might hamper the running of trains, such as the condition of the line during maintenance work or private sidings on the open line, etc. He is not, as in the United States, in direct communication with the train staff. The stations, in this instance, transmit the necessary orders and see that the necessary steps are taken to ensure safe and regular train working.

As a rule the controller operates at the headquarters of a section and is under the orders of the sectional operating officer. He is in direct touch with all stations on the section by telephone and, in addition, follows up the movement of trains on a graph. Seeing that the controller, in case of a change of crossing place, for instance, restricts himself to naming the new station where the crossing has to take place, and that stations then take the necessary steps to carry out the order, it has not been deemed practical to have recourse to means of communication between the dispatcher and trains. The train personnel receive the necessary orders from stations in writing. On secondary lines a crossing may be transferred to an unstaffed station, in virtue of special regulations. In this case the controller may proceed in the same manner as the station master of an ordinary station.

The controller does not intervene in shunting at stations but he can, in case of need, give instructions for expediting same.

QUESTION 21. — *In case you have organised traffic as set forth in the preceding question, have train men (guards, brakesmen) to :*

- *control shunting movements?*
- *work points?*
- *clean points?*
- *light signals?*

If not, by whom are these duties performed?

As a rule train men on the railways consulted have not to work and clean points, light signals, etc.

On the *Deutsche Reichsbahn* it is incumbent on the guard to direct shunting at unstaffed halts, whereas at staffed stations the traffic official or guard (according to local circumstances) are entrusted with this duty. In case of need recourse may be had to the guard, fireman or « caretaker » at the place, if the latter is a male. Points, etc., are cleaned and signals lighted by the station staff and at unstaffed stations by the permanent-way men.

The *County Donegal Railways* state that trains (fitted with continuous brakes) are only manned by one employee who is responsible for shunting operations and the working of points at unstaffed stations. If an employee, sent from a neighbouring station, is on duty there, it is he who is entrusted with the said duties. In addition, he cleans the points, lights the signals and attends to the cleaning of the station buildings, in case of need. At staffed stations the signalman or station-hand attends to shunting and points assisted in case of need by the train guard. The personnel of such stations have to clean points, light signals and do all other ordinary work. The train men are not responsible for these duties, but must see that the train is able to leave at the time arranged.

On secondary lines of the *Swedish State Railways* the train staff (particularly the guard) is entrusted, at unstaffed stations, with shunting operations and others duties concerning the dispatching of trains. Permanent-way men clean points, etc. As these stations are not equipped with signals there is no maintenance work to do. At staffed stations the train men have, in addition, to assist as far as possible the station staff in shunting, loading and unloading of consignments.

V. — Commercial organisation of stations.

QUESTION 22. — *Are stations on secondary lines open to all kinds of traffic (passengers, luggage, goods, animals, by ordinary goods train or fast goods* *train) on the same terms as stations on main lines? State restrictions if any.*

It may be said that, as a rule, stations on secondary lines are open to traffic on the same terms as those on main lines. The nature and volume of traffic depend naturally on the equipment of stations as regards staff, sidings, etc., available there.

Numerous stations on the *Deutsche Reichsbahn* are open to all traffic whereas others are only open to passenger and luggage, or goods traffic. Moreover, the service on secondary lines is restricted as much as possible. If possible, « managers » are taken on who attend to commercial duties, and in the contrary case the stations are left unattended. In the latter instance a guard or an employee detailed from a neighbouring station deals with the traffic from time to time. Each reduced-service station is under the orders of a centre-station which takes charge of certain operations. The rule is that distances to reduced-service stations are applied for making out fares and carriage charges.

The *South African Railways* classify stations on secondary lines as follows :

a) Stations open to all traffic;

b) Stations open to passengers, luggage and small consignments of goods;

c) Stations only open to passengers, luggage and express parcels.

Unstaffed stations are sub-divided as follows :

1. *Sidings* (places where trains stop and where side-tracks exist), open to passengers, luggage, ordinary and express parcels, complete carloads and, at a few stations, to express cattle traffic.

2. *Stopping places* (halts), open to passengers, luggage, ordinary and express parcels, the forwarding of which the trains-employee can easily deal with.

3. *Passenger halts,* only open to passengers and luggage.

On the *Swedish State Railways* stations are classified in a similar manner but without distinction, in this respect, between main lines and secondary lines. Stations, halts and stopping places are as a rule open to all traffic. On secondary lines the opening hours of stations is, however, restricted as much as the convenience of the public allows. Nevertheless, certain stopping places and halts are not open to all traffic. In a few unstaffed stations goods can be accepted under certain conditions.

QUESTION 23. — *How is the transport of goods organised on secondary lines?*

a) *small consignments;*

b) *complete wagon loads (mixed trains for passengers and goods, goods trains running only on certain days of the week)?*

The organisation of goods transport on secondary lines much resembles, that applied on main lines. Small consignments are generally loaded on to wagons, in the luggage van or in the luggage compartment according to the number of packages and the local circumstances. As a rule, there is a tendency to organise at least one train per day. Complete wagon loads are worked through by means of the ordinary train services.

The *Deutsche Reichsbahn* thus accepts, on mixed trains, goods trains and passenger trains, goods wagons when the volume of traffic requires it. Secondary lines are served every day.

On the *Danish State Railways* goods trains properly speaking do not run on secondary lines. Goods are forwarded by passenger trains (railcars) or by mixed trains.

On the *Great Western Railway,* in certain particular instances, use is made of mixed trains on secondary lines, when the number of wagons does not warrant the running of a goods train.

In case of need, a goods train is run on certain days of the week.

On the *London Midland & Scottish Railway* traffic is divided into 2 main groups :

1. Transport of merchandise and animals by goods trains;
2. Packages, sundry and fragile parcels at a higher rate are carried by passenger trains.

On passenger trains small consignments are loaded into the luggage compartment, or more often into the guard's compartment. When the number of parcels does not require a through wagon, goods are usually carried in a covered wagon attached to a daily goods train that runs to a fixed schedule. The train stops at all staffed stations and ensures connections at junction stations. Complete wagon loads such as horseboxes, cattle trucks, milk vans, etc., can be coupled to passenger trains. Ordinary goods wagons and mineral wagons are despatched by goods trains, at least one train being run in each direction per working day. The goods train ensures the necessary connections at junction and marshalling yards.

Mixed trains run on isolated sections which, however, are not numerous.

The *Midland and Great Northern Railways* have no mixed trains on their lines. Small consignments are carried in covered vans by daily goods trains, whilst complete wagon loads are forwarded either by through or local goods trains.

The *South African Railways* use tranship trucks for carrying small consignments of goods. These wagons are despatched to a collector-station where the goods are transferred into other wagons which proceed to the destination of the goods. Packages accepted at stations on secondary lines are carried in tranship trucks or in the luggage van. Only a few secondary lines are served by passenger trains properly speaking. Most of the trains are mixed and at peak times are supplemented by goods trains. Ordinary mixed trains carry passengers, parcels and complete wagon loads.

The *Great Indian Peninsula Railway* carries small consignments every day in district wagons or tranship wagons attached to goods trains or to mixed trains, according to circumstances. Complete wagon loads are despatched in the same manner.

On the *County Donegal Railways* (Ireland) small consignments are carried by steam trains or railcars. The latter then haul a goods wagon. It is claimed that retail traffic is carried more advantageously by frequent railcar services than by steam train. All steam trains are mixed (goods wagons being attached behind the passenger coaches). There are no goods trains properly speaking that run on certain days of the week. Only when an abundance of traffic makes it necessary are railcars run three times a week, whilst steam trains run on the other three days.

On the *Great Northern Railway* (Ireland) goods trains usually include a tranship wagon for carrying goods of insufficient bulk to require the use of complete wagon loads. The tranship wagon is dispatched, for transhipping purposes, to a junction station whence the goods are conveyed to their destination. Complete wagons are also hauled by goods trains. In no case are goods trains or mixed trains only run on certain days. Only on a few sections on which traffic is irregular are goods trains run when required.

On the *Netherlands Railways,* small consignments are carried as follows : express and « fast » packages usually by passenger train; « slow » packages by goods trains in through wagons but in the case of a few services, of lesser importance, also by passenger train.

« Fast-traffic » complete wagon loads are usually sent by passenger train and

« slow » complete wagon loads either by goods train or, for less important connections, also by passenger train. Goods trains run every workday.

Transport of small consignments or complete wagons loads on the *Swedish State Railways* is regulated by the timetables drawn up by the Management both as regards main lines and secondary lines. Parcels are carried by the regular services which, however, do not comprise special wagons for this purpose, slow retail goods traffic is transferred into tranship wagons on certain routes or into through wagons when the amount of traffic requires it, or finally into goods wagons without special destination used for picking up and unloading at intermediate stations. On lines where traffic is light, goods trains only run sometimes on certain days of the week, daily services being nevertheless maintained by passenger trains.

QUESTION 24. — *How are goods weighed, with a view to ascertaining the cost of transport?*

Goods are generally weighed on scales or weigh-bridges, according to circumstances. Most of the stations are provided at least with scales. If there are no scales at the departure station consignments are weighed at an intermediate station or at the destination station. The weight given by the consignor is sometimes taken as accurate, but verifications are made from time to time. If a consignment consists of homogeneous packages, the weighing of part of them, say 10 %, is considered sufficient.

On the *Deutsche Reichsbahn*, at stations managed by an « agent », it is the latter who does the weighing. At stations where there is no staff or where there are no scales, the consignment is forwarded to a main station where the weighing and rating is done. If luggage cannot be weighed at the departure station, it is nevertheless accepted and is then weighed at the arrival station.

On the *South African Railways*, according to the regulations in force all consignments must be accompanied by a waybill mentioning the gross weight. At all stations and a few « sidings » there are, however, scales and at a certain number of stations weighbridges with the aid of which consignments can be weighed for a fixed charge. Weighing is done solely for the purpose of making out the charges and the railway accepts no responsibility to the buyer or seller, or towards the consignor or consignee. Where there is no weighing appliance, such as at « sidings » or « stopping places », and if the weight cannot be estimated by a railway official, the consignment is sent to the station best suited for this purpose. The consignor and consignee are afterwards informed of the weight.

The *South Indian Railway*, which has supplied a detailed statement as to the weighing methods in various cases, points out that even if the consignor has indicated the weight, all consignments must, as far as possible, be weighed before being dispatched. For certain categories of goods there are special prescriptions. If a wagon is to be weighed at the nearest station provided with a weighbridge, that station must be informed of this as soon as possible. After weighing, the forwarding station and the receiving station are informed of the weight by telegraph. If there are no scales either at the forwarding station, the receiving station or an intermediate station, the weight is estimated at half the carrying capacity of the wagon if it is evident that the weight amounts to 81 mds at least, and at a full net load if the weight exceeds 81 mds.

On the *Netherlands Railways* packages (less than full loads) are weighed, unless there are no means of so doing, as well as complete wagon loads of goods, on request; complete loads, for which weighing has not been requested, are nevertheless weighed as far as possible by the railway.

On the *Swedish State Railways* all staffed stations are as a rule provided with scales. The weight has always to be shown on the waybill. If the forwarding station has no weighbridge, complete wagons are weighed at another station en route. The latter inscribes the weight on the waybill and informs the forwarding station of same. In unstaffed stations that are not provided with scales, weighing must usually be done at the central station, which makes out the waybill and calculates the carriage charges.

On the *Swedish Private Railways* packages or wagons are weighed at a central station, or else the weight is estimated.

QUESTION 25. — *State the steps taken (if any) for lessening or simplifying the assessing of goods at stations on secondary lines. Can they ask a centre-station (or the dispatcher) to tell them the amount to be charged?*

The replies received show that no particular dispositions have had to be made for reducing or simplifying the operations incumbent on stations on secondary lines as regards the making out of carriage charges. All stations are supplied with tariffs and distance-tables, which facilitates this work. If there is no rate for a certain object to be carried, or if new traffic arises for which no tariff has been drawn up, a station must apply to the Management, to the « System Rates Office » or to similar organisations to obtain the necessary information. On the contrary, it is not the habit for stations to apply to a centre-station or the dispatcher to enquire for the rate to be applied.

On the *Deutsche Reichsbahn*, in the case of stations staffed by an « agent » (or « manager »), the « Reichsbahndirektion » decides whether the charges are to be made out by the said agent or by a centre-station. If the agent cannot figure out the charges with the help of his tariff, he is bound to request the necessary information from the centre-station. As regards unstaffed stations, it is always incumbent upon the centre-stations to calculate the charges.

At unattended stations on the *County Donegal Railways* the train guard, after receiving a consignment, takes the waybill and hands it to the nearest centre-station for the charges to be made out. In certain cases an additional charge is made for transport to the centre-station.

On the *Netherlands Railways*, in certain cases, the stations on secondary lines ask a centre-station to inform them of the amount to be collected.

On the *Swedish State Railways* it frequently happens that « halts » and « stopping places » are staffed by a woman — in most instances the wife of the platelayer who inhabits the station building — who is not qualified as a rule to apply rates. In case of need, she asks for the necessary information by telephone from the centre-station and then collects the charges. The other forwarding operations, such as accountancy, are carried out by the centre station. On the *Swedish Private Railways* a centre-station indicates the charges, when requested by telephone. The payment of charges is sometimes done by means of special stamps.

QUESTION 26. — *At unstaffed stations, do you entrust the train staff (guards and brakesmen) with the issue, checking and collection of tickets, registration of luggage, forwarding, delivery, handling and weighing of goods, accountancy work, etc?*

As regards the sale, checking and collection of tickets, it appears from the replies received that these duties, at unattended stations, are performed by the train staff. As regards luggage, the train staff only load and unload it; luggage is in most cases registered at the nearest staffed station or any other station most suited to do that.

On the *South African Railways* the ticket controller (or if there is none, the guard) collects the fares, issues tickets and collects same. The guard makes out transport documents for all kinds of traffic including luggage, which is registered at some suitable station on the line. Additional charges are also collected there. All « sidings », « stopping places » and « unattended stations » are supervised by neighbouring stations. The charges are made out by the first station on the trip and are inscribed on the waybills, etc. already drawn up by the guard. The control stations make up all the accounts for the traffic in question.

On the *Burma Railways* (India) the guards issue paper tickets to passengers entering trains at certain level crossings and collect the tickets of passengers alighting at such points.

The *North Western Railway* (India) only has two sections : (1) Mandra-Bhaun, and (2) Khanai-Fort Sandeman on which there are unattended stations. Passengers buy their tickets from the guard, who also deals with luggage.

On certain sections of the *East Indian Railway* the guard issues tickets on the trains and also deals with the weighing of luggage, etc. In this case the accountancy work is done by the train staff and is handed by them to the management at the end of each period of service.

On the *County Donegal Railways* (Ireland), at unstaffed stations — called « halts » with or without sidings — the guard of steam trains and the driver of railcars issue, check and collect tickets, deal with luggage, mail, and all other kinds of traffic.

On the *Great Southern Railways* (Ireland) the train staff does not issue tickets. The ticket controllers check the tickets, but as a rule they are not in service on secondary lines. It is then incumbent on the staff at stations where passengers alight, or upon the staff of control stations, to collect tickets. The registration of luggage, delivery of same, acceptance and weighing of goods, and the accountancy work are carried out by stations.

On the *Swedish State Railways* the guards or drivers of railcars issue tickets to passengers who enter trains at unattended stations. For the purpose of checking there are « train comptrollers » who carry out test-checks. Guards also check and collect tickets on sections of line where there is no ticket collector at the exit of the stations. On steam trains the guards issue tickets and collect the fares. The reckonings are handed in at the depot stations at fixed intervals. In the railcars automatic ticket-issuing machines have been fitted in several instances, and they have proved very advantageous.

The guards also deal with luggage at unattended stations, but charges are collected by stations.

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As a rule such operations as acceptance and delivery, forwarding and weighing of goods, the making out of transport documents, etc., cannot be carried out at unstaffed stations.

On the *Danish State Railways* consignments handed in before the closing of a station are placed, together with the waybill, in a given place from which they are collected by the train staff; the latter deposists the packages (together with their waybills) intended for such stations.

On the *Kenya & Uganda Railways* goods are weighed and charged for at arrival stations. As regards consignments, it is ordered that they shall be labelled and that a waybill is to be handed to the guard. The consignor has to be present at the loading, and trains will not stop more than 30 minutes without additional charge. The carriage charges are calculated as from the next station. Unloading of goods at destination must be done by consignees. The carriage charges are reckoned as far as the station beyond and paid by the consignor.

On the *Bombay, Baroda & Central India Railway* goods are not accepted at unattended stations except in a few rare cases. Charges are made out by the nearest station having the necessary staff.

On the *Swedish State Railways* the train staff deal, at halts and stopping places attended by a woman, with the loading and unloading of goods, and shunting necessary to bring the wagons to and from the loading ramp. On certain lines goods are forwarded without waybills. In this case the guard has numbered forms, in duplicate, of which one copy is to be handed to the consignor as a receipt for the charges paid, and the other to be pasted on to the package. At unattended stations goods are loaded and unloaded by the train staff, helped by the customer; but here again the personnel does not weigh the goods, make out waybills, etc.

QUESTION 27. — *Are there any instances in which a driver who works a railcar alone issues, checks and collects tickets at unstaffed stations and, in case of need, handles goods? What are the precautions taken to allow a driver to leave his stand?*

When railcars are manned by 2 employees (1 driver and 1 guard) does the driver, in case of need, help with the handling, etc?

On most of the railway systems consulted, railcars are always manned by two employees. In certain cases the presence of at least two employees is formally stipulated in an agreement made with the workmens' Unions. In the case of railcars manned by two employees, the driver does not as a rule attend to the sale of tickets or the handling of goods.

The *County Donegal Railways* (Ireland) only employ one man on their railcars. This employee issues, checks and collects tickets at unattended stations and, in case of need, handles goods. The experience gained since 6 years shows that there has been no difficulty whatsoever for the employee to carry out his task satisfactorily. There are 30 unstaffed stations (« halts ») served in this manner. When leaving his stand a driver has to put on the brake, but as a rule he has not to leave the vehicle. If the train is accompanied by a second employee (a workman, maintainer, etc.) the latter assists the driver with the handling of parcels, luggage, etc.

The *Polish State Railways* propose to apply the system mentioned in the above question to lines carrying light traffic.

On the *Swedish State Railways* small railcars are generally worked by a single man who drives, sells, checks and collects tickets at unstaffed stations, and loads and unloads parcels, i.e. his duties are the same as those of a motorbus driver. When a driver has to leave his cabin he is bound to remove the ignition key. Another safety element consists in the « dead-man's handle » with which the vehicle is fitted.

If the vehicle is manned by two employees, the driver has not, as a rule, to deal with passengers and goods.

QUESTION 28. — *State the working hours (actually on duty — duration of intermittent work — extent of service) of train staff (drivers and guards). Are they the same as those of train men on main lines?*

State the working hours (actually on duty — duration of intermittent work and extent of service) of station em-

ployees on secondary lines. Are they the same as at stations on main lines?

The working hours of *staff accompanying trains* appears, as a rule, to be the same on secondary lines as on main lines. They are based as much as possible on the 48-hour week (6 days of 8 hours). Overtime and duty on Sundays are paid for according to special rules. Nevertheless, on several railway systems the working hours are not uniform.

Thus, on the *Deutsche Reichsbahn,* in accordance with regulations on hours of duty, not more than 48 hours may be worked within a period of 7 days in the case of hard work. In other cases up to 57 hours may be worked. The mean duration of work for a period of 7 days is obtained by dividing the total number of hours worked during a certain period (at the end of which the shift re-starts) by the number of days comprised in this period; the figure thus found is multiplied by 7. Reserve duty is considered as 50 % of actual service, but may in certain cases be counted as 60 to 80 %. Intermittent rest-hours are not included.

A turn of duty which includes actual service, reserve service, time-off and « Fahrgastfahrten » (*) may not, for non-travelling operating staff, amount to more than 9 hours in the case of hard work; in other cases it may run up to 12 hours. In certain cases a turn of duty may even be 16 hours, especially on secondary lines. After working for a lengthy time, a long rest — preferably night rest at home — is prescribed. For the locomotive staff it is laid down that the normal turn of duty shall not generally exceed 9 hours. These working hours are strictly limited to 8 hours for passenger-train duty.

On the *Kenya & Uganda Railways* the normal working day for the locomotive and train staff is 10 hours on main lines and secondary lines.

On the *South African Railways* the turns of duty of this staff are based in the first instance on the timetables. They may vary between 6 to 12 hours per day. On principle, the minimum rest period outside the depot station is fixed at 8 hours, and otherwise at 12 hours. The working hours for the locomotive staff are based on the 8-hour day system, 96 hours having to be worked in 14 days. Overtime and Sunday work are paid according to special regulations. The same principles are applied to train men, except that a 9-hour day is to be taken as the basis, with a minimum of 108 hours of work per fortnight including 12 working days.

On the *Bombay, Baroda & Central India Railway* the working hours are 8 to 10 a day.

The *Great Indian Peninsula Railway* states that there is no recognised limitation as regards working hours for the personnel in question. Nevertheless, in actual practice, an immediate rest is granted as far as possible when a service has exceeded 12 hours a day. The same principles are applied to main lines and secondary lines.

On the *East Indian Railway* the hours of work of the locomotive and train staff vary according to the nature of the duties performed. The number of hours drivers and guards have to work is not fixed, but varies between 50 to 60 a week.

On the *County Donegal Railways* the working hours for drivers of steam locomotives and of railcars, firemen and guards amount to 8 a day. No break is granted except when, at the station to which they are attached, the staff can absent themselves for an hour to partake of their meals. In that case the number of working hours may be raised to 9 a day.

On the *Netherlands Railways* the working hours are — as on the main

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(*) Journeys made by railway personnel to get to their work and back home.

lines — 114 hours per 14 days for head guards and guards and 12 hours a day as the maximum.

On the *Dutch East Indies State Railways* the maximum is 13 hours per day, and 286 hours per 4 consecutive weeks. The same standards are laid down for train men on main lines.

On the *Swedish State Railways* the number of working hours is based on the legal 8-hour day. For practical reasons, this duration has been fixed at 208 hours at the most per month of 30 days (26 working days of 8 hours each), whilst on the *Swedish private railways* it is 208 hours per month of 30 days and 234 hours in small stations, according to agreements. The number of hours worked actually by drivers is 160 hours and by guards 185.

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As regards the *non-travelling staff*, the prescriptions regulating the working hours of train staff are in force. In certain cases the turns of duty of non-travelling staff may be somewhat longer.

On the *Kenya & Uganda Railways* the total working hours amount to 10 to 12 a day.

On the *South African Railways* the number of hours worked varies, according to the nature of the work, from 8 to 10 a day. If the working hours exceed 54 a week, a reduced service is arranged during a week or else a day-off is granted once a fortnight or two days a month without loss of pay.

On the *Bombay, Baroda & Central India Railway* the working day is 12 hours for non-travelling staff on all lines when the service includes breaks.

On the *Great Indian Peninsula Railway* the working hours of non-travelling staff on secondary lines are regulated by the « Employment Act », which also applies to staff on main lines.

On the *County Donegal Railways* the legal 8-hour day is in force but may be increased to 12 hours to take into account breaks for taking meals.

On the *Netherlands Railways* the actual work during two weeks is 90, 96, 102 or 114 hours, dependent on its nature. The nominal duration of work, depending also on its nature is :

a) 10 hours at the most, or

b) twice per 14 days : over 10 hours but not over 14 hours.

Rest between two service periods : every two weeks twice 10 hours and for the remainder, 12 hours.

The rest-time between two weeks must be 30 hours at least; this break must fall on a Sunday every three weeks. The duration of a Sunday off-duty must include the period between two a. m. on Sunday and four a. m. on Monday.

The working hours are the same as for station staff on main lines.

On the *Dutch East Indies State Railways* the same regulations are in force for non-travelling staff on secondary and main lines.

Swedish State Railways. — The regulations fix the number of working hours at 208 at the most per month of 30 days. For intermittent work the nominal duration of work is converted to coincide with a certain reduced duration of actual work. For this reason it is possible to increase the working hours for certain services to 234 and even 260 per month. The cases to which this prolonged duration is to be applied are decided by the management after consulting a committee composed of 3 delegates from the management, 3 delegates from the staff and an impartial chairman appointed by the Government.

QUESTION 29. — *Are all stations on secondary lines obligatorily staffed by permanent railway officials, or can their management be entrusted to a private person bound to the railway by a contract ? Have any special precautions* *been taken for the selection of such persons and are the same working hours applied to them as to permanent railway staff, or are they considered as contractors for their own account? Have you entrusted to such private individuals duties concerning the safety of train running (signalling trains in and back; working points, signals, level crossing gates, etc.)?*

As a rule, stations on secondary lines are staffed by employees belonging to the permanent railway staff. In only a few cases is the management of small stations entrusted to private persons (called « caretakers », « managers », « agents », « supervisors »).

The *Deutsche Reichsbahn* distinguishes three categories of stations on secondary lines :

those that are staffed, constantly or periodically, by employees belonging to the permanent railway staff;

those that are staffed by « agents »;

those that are unattended.

« Agents » performing operating duties must fulfil the conditions required from railwaymen. All « agents » must be trustworthy, and they are often chosen from retired railwaymen.

On the *Danish State Railways* small stations are staffed by « managers » bound to the Railway by a contract. Before being engaged, they undergo an examination for fitness. The working hours, fixed by the railway, are the same as those applied to regular railway servants. Train crossings cannot take place at stations staffed by « managers ». The latter may not signal trains in and back, but in case of need they work barriers and signals.

On the *Netherlands Railways* the management may be entrusted to a private person bound to the railway by contract. « Managers » must be recognised as honourable persons; they are considered as contractors for their own account.

On the *Polish State Railways* stations closed on account of decreasing traffic, are transformed into railway « agencies » and served by « agents » bound to the railway by a contract. The commercial duties of an agency are the same as those of an ordinary station. Private agents may be entrusted to work barriers and supervise the lighting of signals.

The *Swedish State Railways* sometimes engage women to look after small stations where traffic is so light as not to justify engaging an agent. Women cannot expect to be regularly appointed on the permanent staff, and are paid according to special rules. Their working hours are fixed by the railway and are less than those of regular railway employees. They perform no duties in connection with the safety of trains, except working the barriers.

QUESTION 30. — *Are there unstaffed stations, i.e. where there is no representative of the railway except when trains stop there?*

If so, what kinds of traffic do such stations handle? How is the acceptance and forwarding of goods done? Is it done by the staff of trains or railcars, and if so must the consigner or consignee be present when trains are due to pass through?

How does the consignee know that goods will arrive for him by a given train?

How are goods weighed and carriage charges made out?

As already stated, there is a good number of stations which are not normally staffed. On several railway systems such stations are then only open to passenger and luggage traffic, and they can be left unattended to the extent considered advisable in view of local circumstances. Various methods are applied in such instances on the different railways.

On the *Deutsche Reichsbahn* the goods are accepted and delivered by the guard during train stops. If stations are only staffed at certain hours of the day — which usually coincide with the times trains are due — it is the « agent » detailed there who attends to the passenger and goods service. Consignees are informed of the arrival of goods by the « agent » and, in the case of unattended stations, by the main station. In the latter case, mention is made of the train by which the goods will arrive and, as regards goods deposited in the goods shed, also the hours during which they can be accepted.

On the *Danish State Railways* there are two kinds of stations that are normally unattended : halts and stopping places. Halts are only open for complete wagon load traffic and stopping places for passenger traffic. Shunting work is performed by the train staff who hand in the waybills to one of the neighbouring stations, which inform the consignor.

The *London & North Eastern Railway* only has a few unattended passenger stations, where the guards issue tickets for local services. There are also unattended goods stations, in the form of « sidings », depending on a neighbouring station. Goods are forwarded in the same manner as at the main station. If goods cannot be weighed at the departure station this is done at the receiving station.

On the *Kenya & Uganda Railways* unattended stations are open to all kinds of traffic. Goods accompanied by a waybill are accepted by the guard. Goods are unloaded either in the presence or in the absence of the consignee. As a rule the consignor informs the consignee of the forwarding of goods but it frequently happens that the control station is able inform the consignee.

The *South African Railways* have appointed « caretakers » for a few « sidings ». They are bound to be present on the arrival of important trains to see that goods are deposited in a shed or other installation. They moreover have to assist consignors in the despatching of goods, of transmit requests for empty wagons to the control-stations, supply information concerning goods on departure or which have not been removed and as to wagons that have not been unloaded by consignees. These « caretakers » are employees who are not entirely remunerated by the railway and who do not belong to the permanent staff.

In other cases users are requested to be present at stations when trains are due or to deposit there at their own risk goods (accompanied by a waybill), to be picked up by the trains. Consignments sent to these points are unloaded by the guard at the risk of consignees. There is no obligation to inform a consignee of the arrival of a consignment which is not immediately removed. When a consignee desires it, an advice may be given verbally or in some other manner, without however any responsibility being incurred by the railway.

On the *Bombay, Baroda & Central India Railway* there are unstaffed stations called « flag stations ». At a few of them consignments are accepted by the guard, but the goods are weighed and the charges made out at the nearest station having a competent staff. As a rule, consignments for such points are not accepted.

The *County Donegal Railways* state that some of their 30 unattended stations are only open to passengers, when there is no other traffic. In most instances all consignments are accepted, either by the guard or by the driver or, in most instances, by an employee from a staffed station who is detailed each day or each week for certain hours. This employee advises the consignee verbally or by post and an appointment is made at a suitable hour for the acceptance or delivery of consignments. The public finally accepted this system when it realised that it could not expect to be served all day long, owing to the light goods traffic offered. Consignments are weighed on the spot by the travelling employee, but charges are made out by the control station.

The *Great Southern Railways* (Ireland) have, for a few « halts », engaged a caretaker who handles goods traffic. He weighs the consignments, the charges being made out by the nearest control station.

The *Swedish State Railways* have a few unattended stations at which goods are accepted only by the train staff. Nevertheless, the service as a rule only applies to packages or sometimes only to small parcels. The train men load and unload the goods. Goods are unladen even if the consignee is not present on arrival of a train on condition, of course, that the carriage is paid. On certain lines no advice of the arrival of goods is given by the railway; on others, on the contrary, an advice is sent by the main stations. Goods are weighed either at a station or by the guard who is provided with small scales for this purpose on certain lines. The charges are made out either by the main station or by the guard. The traffic in question is naturally of little importance.

QUESTION 31. — *Has the application of simplified working methods necessitated, in certain cases, the re-arranging of previous installations or the construction of special installations?*

It appears that not many alterations have been made to existing installations on secondary lines as a result of the application of simplified operating methods; equally, special buildings have only been created in a few exceptional cases.

The *Deutsche Reichsbahn* has had the telephonic communications improved. At unstaffed stations, depôts have been installed as far as possible, to put consignments under cover.

The *Danish State Railways* state that the employment of a less skilled staff at certain stations has required the installation of safety appliances which otherwise would not have been necessary.

The *London Midland & Scottish Railway* states that all platforms have been raised to facilitate the embarking and alighting of passengers. At « halts » where there are no raised platforms, special appliances such as folding steps (on the coaches), stools or step-ladders, have had to be provided.

On the *Swedish State Railways* most stations on secondary lines, in particular those staffed by women-agents, are so arranged that the booking-office, the waiting room, the goods shed and station quarters are united in a single building, which makes the work much easier. Seeing that the building stands back from the main track, a special type of bridge has been provided for transhipping goods between wagons and the shed. When out of use this bridge can be removed to give free access to the adjoining sidings.

At small unattended stations a small cabin enclosed by walls on three sides and a small platform have been built. These stations are often provided with a signboard « Passengers embark here », to warn drivers. The place can also be lighted electrically at night by means of an automatic device.

QUESTION 32. — *How are requests for empty wagons made by the public, and how is the forwarding of loaded wagons done?*

Requests for empty wagons at staffed stations must be made as a rule to the station master who, on certain railway systems, may place empty wagons at the disposal of the public if there are any available in the station; on other railways the station master must apply to a higher authority. As to unattended stations, it appears to be the rule to forward requests for rolling stock to the station master of a neighbouring station.

Complete wagon loads are forwarded by the trains designated in the timetables.

On the *Deutsche Reichsbahn*, requests for wagons are addressed to the « agent » (or manager). If a station is unattended the request must be made to the nearest staffed station or to a guard who hands it in to the main station. Complete wagon loads are forwarded by trains in compliance with the waybill made out by the « agent ». At unattended stations it is the consignor who hands the waybill to the guard of the train by which the wagon is despatched. In certain particular cases other methods can be used.

On the *South African Railways* requests for wagons must be made at least 48 hours ahead.

On the *Bombay Baroda & Central India Railway* requests for rolling stock at unstaffed stations are handed to train guards. Empty wagons are supplied to the public next day. When the loading is completed, full wagon loads leave by the first train.

On the *Polish State Railways* clients hand requests for wagons to the « agent »; after the wagons are loaded, and after having fulfilled all formalities on the spot, the agent despatches the wagons in the required direction.

QUESTION 33. — *How is the accountancy work of staffed and unstaffed stations done ? Is there a centre-accountancy-station centralising all the accountancy work of a line ? If so, what accountancy work remains to be done by a station « superviser » (station managed by a private individual) and how are goods despatched to their destination (must it be via the centre-accountancy-station) ?*

Describe, if the case occurs, the organisation of the accountancy on a secondary line on which stations are not staffed constantly or are only managed by a person who is not a permanent railway official.

According to replies received from the Railways consulted, the accountancy work at staffed stations is almost invariably done by the staff of such stations, applying the general rules in force. The accountancy of unattended stations is as a rule kept by the neighbouring station most suited for this purpose. In a few exceptional cases the latter may also deal with the accountancy of certain staffed stations of lesser importance. There are no cases of central-stations who do the accountancy for the stations of a whole line.

On the *Deutsche Reichsbahn* it is incumbent upon the centre-station to make up all accounts. Nevertheless, at stations staffed by an « agent », the work may be entrusted to the latter.

On the *Great Western Railway* the accountancy of 2 to 3 stations is, in certain instances, centralised at a centre-station to which transport documents are sent for accountancy purposes after the arrival station has used them for collecting the charges.

On the *Kenya & Uganda Railways* consignments forwarded from « closed stations », « immediate sidings » and « halts » are entered on the « guards' siding traffic ticket », made out in triplicate, the first copy of which accompanies the consignment as far as the arrival station, after which it is sent to the chief accountant. One copy is sent to the superintendent of the line with the « train report » and the third copy remains in the booklet for accountancy purposes. In certain cases this « ticket » is not obligatory, for example for luggage registered by a neighbouring « open » station, in the case of consignments forwarded to destinations on the Tanganyka railways, certain ports and another « closed station », « siding » or « halt » etc. In these cases the waybill must as a rule accompany the consignment. The requisite documents are made out by the first « open » station. Consignments arriving at stations of this kind must comply with the conditions of the « Official Tariff Book » and the carriage must be paid in advance.

On the *East Indian Railway* the number of unattended stations is small. Their accountancy work is generally performed by the depot station of the personnel who attend to the service in unstaffed stations at hours when trains call there. In staffed stations the personnel is responsible for all accountancy work. The system applied to staffed stations is also in force at stations looked after by private individuals bound by contract. All accountancy documents of staffed or non-staffed stations are sent to a central office at the railway headquarters.

On the *County Donegal Railways* at the end of each month the station master draws up the operating-report and counts the cash which is then handed to the accountant's office at headquarters at Stranorlar for checking purposes. For joint traffic with other railway companies, a complete set of accountancy is sent by the management to « The Irish Railway Clearing House » at Dublin, which divides up the money and draws up monthly accounts. The documents concerning unattended stations are joined to the report of the station master of the neighbouring control-station.

On the *Netherlands Railways* staffed stations generally do their accountancy themselves. Nevertheless, staffed stations of lesser importance, not having the requisite competent personel, add up their receipts and expenses on a special printed form which is sent to a neighbouring station entrusted with the management of such stations. The same applies to stations looked after by a private individual.

The principal station appointed comprises the accountancy of subordinate stations in its own accountancy.

Unattended stations have no accountancy duties to perform.

Goods are forwarded direct, as regards staffed stations; through the medium of a centre-station in the case of unattended stations.

On the *Swedish State Railways* stations staffed by women hand the takings and transport documents to the main station entrusted with the accountancy of its branch-stations. As a rule, the principal stations also make out the carriage charges for consignments from unstaffed stations unless the train staff have to report by means of particular receipts the carriage-charges paid in.

QUESTION 34. — *State the number of stations where the simplified methods described in the foregoing (questions 29 to 33) are applied and to what extent these methods have been developed since 1930?*

Only part of the Railways consulted have given detailed information concerning this question.

The *Deutsche Reichsbahn* has supplied the following information which includes all lines (main lines included) :

—	Number of stations.	
	Unattended.	Caretaker in attendance.
At 31st December 1930.	1 058	1 905
At 31st December 1931.	1 165	1 986
At 31st December 1932.	638	2 052
At 31st December 1933.	1 138	2 180
At 31st December 1934.	1 135	2 204

The *Danish State Railways* mention that the number of stations exclusively staffed by private individuals bound by contract is 45 (17 in 1930). The number of stations partially staffed by an « agent » not belonging to the permanent staff is 100 (5 in 1930), 24 of which (8 in 1930) are unattended for certain trains. There are, in addition, 19 (21 in 1930) unattended « halts » and 82 (65 in 1930) unattended « stopping places ».

The *London Midland & Scottish Railway* considers it may be of interest to mention that it has always been the custom to employ private persons in the capacity of cartage contractors for collecting and delivering goods when the traffic at a station does not justify the setting up of a normal cartage service.

On the *Midland and Great Northern Railways (Joint Committee)*, there are no stations staffed by private individuals. The number of small stations under the orders of a main station is 5.

The *Kenya & Uganda Railways* have 24 unattended stations and 52 harbour stations also unattended.

The *North Western Railway* (India) has unattended stations :

on the *Mandra-Bhaun section*, between Mandra and Taragarh and between Daulatala and Sayyad Kasran;

on the *Khanai-Fort Sandeman* section, at Rahimgul Sarai and Badinzai which are « closed stations » where trains stop for the locomotive to take water.

On the *East Indian Railway* the number of stations is 320. The methods for dealing with traffic at these stations have not changed since 1930.

The number of unattended stations (« halts ») on the *South Indian Railway* is 6.

The *County Donegal Railways* state that 30 stations have been transformed into unattended « halts ».

On the *Polish State Railways* about 80 stations have been transformed into « agencies » since 1930. It is proposed to extend this procedure in the future, when the necessity arises.

On the *Swedish State Railways* simplified operating methods are applied at 290 stations of which 87 are only open to passenger traffic. Since 1930 the development consists in the creation of a large number of unattended stations only open to passenger traffic. On the *Swedish private railways* there are 31 stations where simplified operating methods are applied.

SUMMARY

The advent of road motor transport and its great development laid weighty problems before the railways. Indeed, motor transport, availing itself of the extensive network of public roads, is able to come into closer contact with users and secure their traffic more easily than is the case with railways. Road motor vehicles are able, in addition to pick up and set down passengers at places that are most suitable for them; the same applies to goods traffic. Experience appears also to have shown that traffic has been taken from the railway by road transport to an appreciable extent. That is especially the case as regards occasional users paying full rates, as also consignments of parcels and packages, the loss of which has had a marked influence on railway finance. The railways hardest hit economically are those whose secondary lines run through thinly populated districts where traffic, for natural reasons, is only light. Competition between the two methods of transport has had the result of practically ending in several countries, the construction of new railway lines.

On those secondary lines which continue to be operated, Railway Administrations have been compelled to take drastic steps to simplify their working with a view to obtaining a satisfactory financial result or, at any rate, to reduce their deficits as much as possible. Means for thus reducing expenses must be sought in the first instance in the equipment of the track, which it has been attempted, from the start, to adapt to the light traffic anticipated on such lines. On the other hand, as regards operation properly speaking, it has been possible to obtain important results and it appears that in the future further benefits may be expected from simplified methods now in course of application.

The replies received from the various Railway Administrations consulted touch upon several points of interest as regards organisation of operating services on their secondary lines. It appears, notably, that Managements are free to issue, themselves, regulations regarding this matter, which is doubtless very advantageous owing to the constant changes that require very flexible adaptation.

From the standpoint of rational simplifications, great importance must be attached to working regulations well adapted to the less important circumstances on secondary lines which, owing to light traffic, offer numerous possibilities for simplification. The fact that these lines are jointly managed with main lines should not prevent safety and other regulations being adapted to the particular requirements of secondary lines.

Numerous simplifications concerning the running of trains, signals, signalling in and back-signalling of trains etc., have been introduced, but much certainly remains still to be done in this respect.

The motive power and rolling stock factor is of great economic importance from the standpoint of the reduction of operating expenses on secondary lines. It appears that these problems are being dealt with everywhere, especially as regards rail motor vehicles. The rapid development of this traction method is worth while following up closely. Railcars and locotractors have, in many respects, proved that they are capable of largely contributing to economical operation : both by the reduction of the number of employees on trains, whence a lowering of expenses on wages, and by a reduction in running and maintenance expenses as compared to operation by means of steam trains. The use of railcars also provides appreciable advantages for users : frequent runs, increased commercial speed, numerous stops, etc. On the other hand it must be admitted that the use of railcars is not from certain aspects, free from drawbacks and restrictions. When traffic expands considerably or is subject to sudden fluctuations, it appears necessary to retain steam trains, which can be better adapted to such circumstances. For that reason it is difficult to set forth any general rule. The working method selected depends consequently on the circumstances existing on the line in question.

With a view to achieving satisfactory savings it is advisable to reduce the weight of trains as much as possible. When endeavouring to put this suggestion into practice, railways are hampered in particular by the presence of more classes of compartments or more seats in a particular class than is necessary. If a single class is not sufficient owing to particular circumstances, it appears nevertheless advisable to examine whether it is not possible to restrict the classes to two. On the other hand, by making careful use of the carrying capacity of wagons for goods, appreciable results can be obtained as regards the weight of trains. In this respect, the importance must be stressed of restricting to a minimum the number of types of wagons and of standardising the rolling stock.

As mentioned above, it is of capital importance if economical operation is to be obtained, that attention be paid to the question of personnel. Attempts must be made to obtain a reduction in staff by organisation measures in all departments. A judicious restriction of operating plant and a good use of the personnel are two fundamental factors making for satisfactory financial results.

As regards secondary lines carrying only light traffic, our enquiry shows that railways favour unattended stations where the train staff or a private individual, who does not belong to the regular railway staff, deals with traffic. In other cases stations are managed by « agents », (« caretakers ») either a man or a woman, and the opening hours of stations are often reduced to a few per diem. The number of stations resembling those on main lines has, thanks to these methods been reduced to a minimum. In addition, it has been possible to impose several duties, with which non-travelling staff are usually entrusted, to train staff who are not fully occupied, owing to light traffic.

As the result of various steps, it has also been possible to reduce the staff of permanent-way men for guarding level-crossings, track walkers, etc. In this respect it is curious to note that the use of automatic appliances for warning road users at level crossings is so little developed. Even if this installation entails a certain outlay, it has nevertheless proved itself advantageous in several instances and from many points of view.

It is evident, however, that a reduction in staff must not be of such a nature as to harm the legitimate interests of railway users. It has been possible to introduce simplifications in passenger and goods traffic without causing any inconvenience to clients. Everything that can be done in this respect should be attempted in view of the benefits that can be obtained : the number of specially instructed staff can be reduced to a minimum, the expenses on fixed installations can be lowered, etc.

Finally, we feel we ought to stress the fact that, even if road motor competition is of great importance to railway finance, sometimes to such an extent that the question is raised of closing a railway line, it may nevertheless be justly claimed that, both at present and in the future, it may be considered as a vital factor for a country and its inhabitants to possess a railway system rigorously managed on modern and scientific principles.

[625. 611 & 656. 27]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION XIII.

Specifications for the fixed plant of railways with light traffic, intended to prevent the use of unnecessarily expensive track equipment, and generally to give economical working.

REPORT

(Great Britain, Dominions and Colonies, America, China and Japan),

by M. VAN NOORBEECK,

Ingénieur, Directeur des voies et travaux, Société Nationale des Chemins de fer Vicinaux (Belgium).

The complexity of this question means diversity of interpretations. The object of the present study is to state generally the technical and operating methods to be used to reduce capital costs and working costs.

Companies operating railways have been forced by road competition to modify fundamentally their operating methods, and by deduction, it appears logical to see if the cost of the fixed plant cannot be adapted in turn to the new operating methods.

In spite of the somewhat conservative outlook of permanent way engineers, it has become evident that the development of the track and its equipment can no longer be independent of that of the motive power and rolling stock, but the two departments must work together if the savings from sound management are to materialise.

The different railway companies have dealt with the permanent way, the rolling stock, and the relation between them. So far, however, no distinction has been made, in designing the track, between railways with heavy traffic and those with light traffic.

60 Railway Companies operating 226 800 km. (140 930 miles) of track have been consulted.

13 companies have replied that, as their railways did not comply with the specified conditions, the questionnaire did not apply to them; 12 other companies were good enough to send information for which we sincerely thank them. These companies represent a length of 13 356 km. (8 300 miles) in operation.

The large number of companies not replying or replying in the negative appears to be due to indecision as to the exact meaning of a railway carrying light traffic.

Various interpretations of the meaning of « lines carrying light traffic », « light railways » or « secondary lines » have been given already in various reports to the Congress and in particular by Messrs. C. de Tolnay (¹) and J. Rocca (²) at the Washington Congress (1905), and by M. F. Level at the Paris Congress (1922) (³).

I agree with M. Level's view that a railway line should only be called « secondary » when it carries only light traffic.

If light traffic implies that the line should be built and operated cheaply, it must not be at the expense of the safety and comfort of the public.

The construction and operation should in consequence be based on other rules and conditions than those applicable to main lines with fast and heavy traffic. Above all they should be free from the standards followed to meet higher speeds, as these necessarily involve much more costly constructional and operating standards.

The twelve replies received were from two railways in the United States of America, three in Great Britain and Northern Ireland, two in British Africa, three in India, one in the Irish Free State, and one in Japan.

Except for one of the American and one of the English lines, both built and operated as standard 4 ft. 8 1/2 in. gauge lines, the other railways can be considered as light railways in the meaning of the questionnaire.

Excepting the system of the American Company, a large proportion of which is double-track, the lines of the other companies are all operated as single-track.

The gauges are : 0.60 m. (1 ft. 11 1/2 in.) 0.76 m. (2 ft. 6 in.), 0.90 m. (3 ft.), 1 m. (3 ft. 3 3/8 in.) 1.067 m. (3 ft. 6 in.), 1.435 m. (4 ft. 8 1/2 in.), and 1.676 m. (5 ft. 6 in).

The companies using the 4 ft. 8 1/2 in. gauge do so for the tranship facilities (passenger and goods) it offers. The other companies prefer the narrow gauge as being cheaper in first cost.

The gradients are heavy on most of the lines, again to keep down the cost of construction, but on those railways built to the standard (4 ft. 8 1/2 in.) gauge, to keep down the working expenses.

All the companies replying to the questionnaire have their own permanent way.

The curves are governed by local conditions, the radii being as large as possible, with parabolic transitions.

The speed of the trains is from (40 to 60 km.) (25 to 37 miles) an hour.

The axle load depends on the weight of rail used. Both the weight and length of rails vary widely; the weight from 15.8 kgr./m. to 65 kgr./m. (32 to 130 lb. per yard) and the length from 7.30 m. to 12 m. (24 to 39 ft.). One English Company uses bull-headed rails, but all the others Vignole rails.

The rails are laid with square joints, sometimes staggered on curves. The joints are suspended; the fish-plates are either flat or angle bars, no marked preference being noticed. No company welds its rails.

The rails are laid on sleepers, usually wood creosoted by the Rueping process. One company uses steel sleepers except under points and crossings and on bridges, where wood sleepers are used. Hard wood (oak) is generally used. The dimensions of the sleepers vary with the gauge and the length of rail used.

Opinions are divided as to using bearing plates between rail and sleeper.

The ballast is usually gravel or broken stone.

The points are generally built up from rails, with straight blades. Automatic control of points is not resorted to.

The length of holding sidings is determined by the amount of traffic. Many of the companies build their secondary

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(¹) See *Bulletin of the Railway Congress*, February 1905.

(²) See *Bulletin of the Railway Congress*, December 1905.

(³) See *Bulletin of the Railway Congress*, October 1921.

lines from serviceable material recovered from their main lines when relaying.

As a rule the lines are not fenced in, but sometimes main stations are fenced in with concrete posts and wire.

The bridges are built as a rule from local materials, concrete being used whenever possible, in order to keep down maintenance costs.

Turntables, either boarded over or not, are rarely used. In some instances open tables are provided at the main stations and junctions. Shunting triangles are used instead wherever practicable.

Weighbridges are in general use, the number being governed by traffic requirements. They are usually hand-operated.

Passengers exchanged with the main line railways at the joint stations change train, the tracks being separated by ordinary open platforms. One railway provides footbridges or subways.

Goods are exchanged by transhipment at a platform between the lines. In some cases there are special tranship stations with special mobile cranes for dealing with heavy loads.

The stations are provided with the minimum accommodation required for the goods and rolling stock departments; but rarely is any provision made for the passengers. The buildings are usually made of wood or metal plates with corrugated sheet roofs.

Usually the points and crossings and the points leading into the stations are protected by manually-operated interlocked signals.

The safety and regularity of running of the trains is ensured by the ordinary train staff or electric train staff.

The stations are protected, generally speaking, by a home line and starting signals, without distant (repeater) signals, except possibly at important junctions.

The signals are hand-operated and are lighted at night with paraffin or oil lamps. One railway uses gas or acetylene, or electricity if the latter is available.

The points are always padlocked and are operated in situ. When the block system is used, it is always absolute.

The stations as a rule are connected by telephones complementary to the train-staff system.

The wires are carried on wood or concrete poles; the telephones are usually installed by the Government, the cost being debited to the railway company.

The telephone instruments are connected in parallel and in most cases are of the magneto-generator type.

When the telephones of the light railways have to be linked up with those of the main line railways at junctions, cables can be used for making the connection. The Government decides the system. 56 kgr. per km. (210 lb. per mile) copper wire is used, and the voltage is less than 250. One railway recommends that such connections be not made on account of the technical and working difficulties involved.

Level crossings are as a rule only provided with gates in towns or large villages when there is much traffic. The gates are worked by the station staff or by gate-keepers at the company's cost. One company is using winking lights at important crossings.

CONCLUSIONS.

This enquiry could deal with only a few railways in very different countries and consequently no precise conclusions can be come to as compared with a well defined technical question.

It appears, however, that the various Companies who have been good enough to send information are still following the rules governing the construction and operation of the main-line systems; they build and operate their light railway system like their main lines, being even satisfied in some cases to use materials withdrawn from their main system.

To sum up, the railways are built at the lowest possible cost by selecting the gauges most suitable to the intensity and nature of the traffic and the configuration of the ground, by providing the fixed plant strictly required to operate the traffic, and by using suitable rolling stock.

The operating closely follows that of the main lines but is freed to the largest possible extent from the obligation of fencing in the railway, guarding level crossings, providing signals at important junctions, and home and starter signals at stations.

The safety and regularity of train working on the single lines is ensured by the ordinary or electric train-staff system, completed in many instances by a system of telephones.

RECOMMENDATIONS.

In our opinion, the idea of light-traffic railways should be based on rigid rules, not only as regards lower first cost and simplicity of operation, but also as regards the savings in maintenance obtained when the line is well built.

The following recommendations can be formulated :

The gauge selected depends on the amount of traffic to be handled, the gauges of the adjacent railways to be completed in this way, and on various local circumstances, such as the configuration of the district and towns passed through. The 0.91-m. (3 ft.), 1 metre (3 ft. 3 3/8 in.), and 1.067 m. (3 ft. 6 in.) gauges appear to give the best results : the construction can be sturdy though relatively cheap, and the capacity is able to meet all requirements of the public and the traffic.

The weight of rails should not be less than 20 kgr. per metre (40.3-lb. per yard) with 32 kgr. (64.5 lb.) as a maximum. Rails less than 9 m. (30 ft.) long should not be used.

Gradients exceeding 1 in 33 are not recommended. The radius of the curves ought naturally to be proportioned to the train speeds, and should not be less than 30 m. (1 1/2 chains) for low speeds.

The use of treated wood sleepers is to be recommended.

The ballast should be gravel or broken stone, whichever can be obtained most cheaply.

Points and crossings should be robust. The latter can be protected by hand signals, and points be padlocked and hand operated.

The fencing in of the lines, except in the stations, is unnecessary, in view of the low speed of the trains (25 to 45 km.) (15 to 28 miles an hour).

For the same reason, level crossings in most cases can be protected simply by the international sign picturing a locomotive, without gates.

The buildings should be limited to those absolutely necessary for the operating and rolling stock departments.

At intermediate stations buildings are not needed in many cases, platforms edged in concrete being sufficient to meet the requirements.

Signals protecting trains when entering or leaving the stations are not necessary.

The padlocked points can be worked by the station or train staff.

Signals interlocked with the main-line signals are only justified at important junctions with the main line.

The safety and regularity of the traffic over the single lines is amply ensured by the ordinary or electric train-staff system, completed in some cases by a telephone line between the different stations.

[621.392 & 625.143]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION II.

Use of welding :

1. to obtain extra-long rails ;

2. in manufacturing and repairing points and crossings.

a) **Results obtained by using extra-long rails. Methods used to ensure safe expansion of the rails and anchoring of the track.**

b) **Technical and financial results shown by welding points and crossings.**

REPORT

(Germany, Belgium and Colony, Luxemburg, Netherlands and Colonies, Denmark, Norway, Sweden, Finland, Poland, Austria, Hungary, Switzerland),

by Dr.-Ing. MULLER,

Reichsbahndirektor, Oberbäureferent der Hauptverwaltung der Deutschen Reichsbahn.

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Foreword.

The present report has been based on the replies received to a questionnaire addressed to the railways of the countries mentioned above. It follows in its arrangement, the division adopted in the questionnaire. The replies show that the railways fairly agree on certain points, but on others their views disagree. This double aspect of the problem has been taken into account in drawing up this report. The Reporter has taken care to give a review of the present position of each question discussed, pointing out the principles and facts generally or almost generally recognised, and then mentioning the contrary opinions worthy of attention owing to the reasons on which they are based. The application of welding to permanent-way work is still new and in face of the exceedingly rapid progress made in the different processes in a short time, an idea now little known may be the starting point of a further stage of evolution.

All the Railways to whom the questionnaire was sent have not replied. Some of these Railways have only started to carry out tests quite recently. The Railways who sent in replies are listed hereafter :

1. Bergslagen Railway.
2. Deutsche Reichsbahn.
3. Danish State Railways.
4. Göteborg-Boras & Alvesta Railway.
5. Halmstad-Nässjö Railway.
6. Karlskrona-Växjö Railway.
7. Netherlands Railways.
8. Belgian National Railways Company.
9. Belgian National Light Railways Company.
10. Norwegian State Railways.
11. Austrian Federal Railways.
12. Polish State Railways.
13. Prince Henry Railways, Luxemburg.
14. Swiss Federal Railways.
15. Royal Swedish State Railways.
16. Royal Hungarian State Railways.

The report deals with the application of welding for assembling rails, reusable parts of metal sleepers, for welding bearing plates to sleepers, and for building up the worn running surfaces.

A. — Use of welding for making long rails.

The following welding methods have been used up to the present to get long rail lengths :

1. Alumino-thermic (thermit) welding.
2. Resistance (electric) welding.
3. Electric-arc butt-welding.
4. Arc-welding fish-plates.
5. Autogenous (gas) welding.

Of these processes, *thermit* has been most widely used on the railways even though most of the Administrations now use other methods, at least for trial purposes.

The replies received show that :

Welding No. 1 is used by 10 Administrations, and by one in isolated cases;

Welding No. 2 is used by 5 Administrations;

Welding No. 3 is used by 4 Administrations, and by one as a trial;

Welding No. 4 is used by one Administration;

Welding No. 5 is used by two Administrations as an experiment.

Before going any further, it will be interesting to trace the development of welding methods on the Reichsbahn.

The Reichsbahn in 1925 and 1926 investigated the various methods of welding in order to find the one best suited to its special conditions, and included therein arc welding, the use of which has continued to expand since the end of the War, and to-day gives excellent results in many cases.

It is the more surprising that at that period it was not adopted in Germany and elsewhere for welding the rail ends, although the question was so important that experiments and practical tests in this connection had been carried out on a large scale.

The Reichsbahn tests started from the experiments previously made in Germany on the tramways and narrow-gauge railways.

The « Akkumulatoren Fabrik A. G. », of Berlin and Hagen, which introduced arc-welding, studied the question carefully and carried out extensive tests. The first practical tests of welded rails were made in 1906 on the Hagen (Westphalia) tramway by this Company. In these tests the end faces of the rails were *butt-welded* by means of the arc produced between the rail and the electrode. The first results were satisfactory and unfortunately the process was introduced on a wider scale too soon. As we know now, the defects only show themselves after a long time, and it was thus found after several years' service that the added metal desintegrated and broke away.

According to the conclusions of the Reichsbahn enquiry, these destruction phenomena must be sought in the rapid cooling of the added metal and the consequent difference in texture between the rail and the added metal. During arc-welding the heat generated dissipates rapidly and this rapid cooling gives the added metal a hardened structure so that there is a transition zone, between the rail and the added metal, with a much lower breaking strength, in fact too low for the stresses set up therein. The lack of experience at that time explains why these causes were not discovered soon enough.

Later on the welding of the edges of the *fish-plates* to the rails was resorted to instead of the ordinary butt-welding. To start with the fish-plate was spot-welded to the rail and not continuously. Subsequently the welding of the edges was carried a step further by bringing the two ends of the rails into contact and welding the edges of the fish-plates the full length, so that the stresses in the sections in compression be transmitted from one rail to the other.

Joints of this type were made on a large scale, unfortunately the expected results were not obtained. The « Akkumulatoren Fabrik A. G. » and later its successor, the « Elektro-Thermit G.m.b.H. » were obliged to meet their guarantees in many cases and many tramways which had adopted the practice of electrically welding the rails sustained losses.

After a few years service, it was the general experience to find small cracks in the welded upper edge, usually at the rail head. These cracks started from the joint gaps and suddenly turned into the weld to continue in the running direction. In the early days they were extremely small and only visible after thoroughly cleaning with water and brushes. They extended first of all slowly and then more and more rapidly until the crack reached the end of the weld. The crack continued as a rule backwards from the joint gap until the weld had torn away its whole length. The crack formed in the same way in the check rail, but started later and developed with some delay compared with the running rail.

Much later, usually when the weld along the rail head had torn away completely, or almost so, cracks formed in the foot of the rail, starting not from the rail gap but from one end of the weld.

An experienced eye could distinguish the exterior signs of the inception of a crack although this was far from easy owing to the layer of dirt and rust with which it was usually covered. A perfectly welded and sound joint, it should be noted, is not recognisable as a joint when seen from above. Once the joint gap appears, usually after wet weather when the rail top has dried, it is almost certain that a crack, however small, has started in the weld. Careful examination nearly always confirms the diagnosis. If the wheels make any noise when running over the joint, the tearing away of the welds under the rail head is already extensive and the joint becomes more and more defective under the loads until the bottom weld also opens and shows all the characteristics of the loose joint, knocking and chattering, and damaging the adjacent paving (if any), just as occurred in former times with fished joints, and today where such joints still exist.

Such serious destruction of the joint usually occurs at the end of some 4 to 6 years and often later according to the quality of the workmanship which greatly influences the life of the joints, and according to the dimensions of the rail section, the density and weight of the traffic, etc... Furthermore, the whole of the joints do not show signs of defects simultaneously, a small percentage even remaining perfectly sound.

A joint in which the welds have torn away can, of course, only be repaired by rewelding. The crack must be cut out deep and wide enough if the weld is to penetrate deep enough. This operation is costly and consequently is usually neglected with the result that the rewelded joints soon develop the former defects.

Owing to the unexpected drawbacks met with in electrically welded rails, new tests had to be made to ascertain the cause of the failure at the joints. As the tensile tests as carried out until then produced quite other phenonema than those observed in service, welded joints were subjected to repeated impact tests so as to reproduce the working conditions as accurately as possible. A 50-kgr. (110 lb.) tup was allowed to fall 10 cm. (4″) at short intervals onto a joint carried on two wooden sleepers 1 m. (3′ 3 3/8″) apart, embedded in ballast. After some hundreds of thousands of blows, the same failure occurred as in service, i.e. starting from the joint gap, the top edge tore away from the rail head, then from the check rail and finally from the foot of the rail.

Further tests were carried out to see

if a more lasting joint would be obtained by carefully machining and fitting the ends of the rails, by carefully bedding the fish-plates into position, by increasing the number of runs of welding at the joint gap, by using an iron electrode in place of the carbon electrode previously used and by the better quality of weld which should be the result.

The result of these investigations and small improvements was to make the life of the joint under impact several times as long, and it was thought that the life of a joint made in this way would be about that of the rail. The results in service were again disappointing. The careful machining of the joint and the good welding did improve the life in service, but in no way to the extent the shop tests had suggested. Even the best made joint could not be counted upon to stand more than 4 to 6 years.

This was the position of rail arc-welding when the *Reichsbahn started its tests* in 1925.

The lack of success in welding the ends of the rails was undoubtedly due to the impossibility of properly welding over the full cross section the squared ends of the rails. As it was difficult to introduce the electrode into the narrow space between the rail ends, the latter were chamfered off at an angle of 60° on both sides, thereby making an X-shaped groove for the added metal, this shape being more accessible for the welders than the former parallel faces. The impact tests, however, did not give much better results than those of simple butt welds or edge welds of the fish-plates.

Further tests were made *in addition* by *welding a bearing plate* under the rail foot. The mechanical tests were still below those given by thermit-welded joints and much below those of resistance-welded joints.

For a weld of this kind to be a complete success the ends of the rails must be bevelled off each side, so that a welding groove at an angle of at last 60° be available, and the weld must reach all parts of the rail section. The deeper the groove, however, the more expensive is the work, the more metal is to be added to the rail head, and the more costly is the planing of the weld metal from the running surface of the rail.

A weld of this kind is delicate work for a very experienced welder using metal electrodes, involving very great attention and care, so that a large proportion of defective welds are to be feared.

Very little information is available at present on the life of such welds under the hammerblows of the rolling loads. One thing is certain, namely, that the weld metal is extremely brittle and wears in quite a different way from the running surface of the rails, so that from the trials made by the Reichsbahn with added metal at the joints, corrugation must be expected to occur after some time unless, what is worse, the weld metal cracks and disintegrates. Moreover, the welding would become so costly through machining the rail ends and the large quantity of added metal, that, even only for this reason, it was decided to give up the trials in service.

To sum up, it may be said that arc-welding of rails was not adopted by the Reichsbahn because of the adverse results obtained on tramways and narrow-gauge railways on the one hand, and on the other on account of the poor mechanical properties obtained in laboratory tests and the high cost as compared with thermit or electric resistance welding.

1. *Alumino-thermic (thermit) welding* is based on the process invented by Dr. Hans Goldschmidt, in which a mixture of powdered aluminium and iron oxide are submitted in a crucible to a sudden reaction which takes place without explosion if the mixture is heated at one point to the required reaction temper-

ature. Under the effect of the high temperature developed, the aluminium combines with the oxygen of the iron oxide according to the formula $Fe_2 0_3 + Al = Al_2 0_3 + Fe$ in a liquid incandescent mass in which the two elements iron (fe) and aluminium oxide ($Al_2 0_3$) separate very quickly owing to their different density. The heavy iron sinks to the bottom and the lighter aluminium oxide forms a slag which floats on it.

The chief feature of the thermit process is that with few tools and equipment it is possible to produce very quickly, independently of any outside source of heat, extremely high temperatures with large quantities of heat and of iron only depending on the quantity of thermit used. At the same time the conditions are such as to permit the heat being very well used. As the reaction takes place without releasing any gas and as all the products of the reaction are liquid, the whole of the heat generated remains inside the crucible or iron mould surrounding the rail ends to be welded.

These particular properties of thermit make the method especially applicable to welds to be made on the line and in the yards, i.e. at points little accessible with heavy machines and tools.

As regards thermit welding, there are two different methods in principle, namely :

a) *pressure welding* in which the ends of the two pieces to be welded are carefully fitted to one another and after being heated by the thermit are welded by mechanical pressure, and

b) *fusion welding* in which the two parts to be welded together are separated by a gap in which the liquid iron given by the thermit process flows, their temperature is raised until they smelt with the thermit and with one another.

These two methods have their advantages and drawbacks. By combining them so as to get a pressure weld in the rail head and a fusion weld in the foot, the good features of the two methods are retained and the drawbacks avoided.

This so called *combined welding* is used everywhere except when special circumstances prevent it.

In both processes the joint, pre-heated by means of a petrol blowpipe.

Simple pressure welding is rarely used now. In

Fusion welding,

the two rails are left with a 10-mm. (3/8″) gap between their ends. The cast iron mould is like the mould used for butt welding, but with a special filling which feeds into the bottom of he mould.

The reaction takes place in a cone-shaped crucible; a pouring hole is pierced in its bottom, through which the iron flows, filling the mould, and by fusion becomes solid with the ends of the rails. The slag gets freely away.

One drawback of this method is the presence in the rail head of a slice of foreign metal, several centimetres wide, in which cracks due to hammerblow may develop.

Combined welding.

In combined pressure welding including pre-heating of the rail ends, the ends of the rail heads are squared; the rails are brought together with a plate of welding metal between the heads so that there is no gap in the rail head, whilst in the web and foot there is a gap equal to the thickness of the plate.

The two-piece mould is the same as that used with fusion welding. The reaction occurs in the crucible, the quantity of thermit being calculated to fill the mould slightly above the middle of the web. The slag forms in the top of the mould where the joint gap is closed by the plate of welding metal.

After the molten metal is poured the two ends of the rails are forced together so that a pressure weld is made between the rail heads, the webs and feet being already welded up by the thermit.

This process can only be used when at least one of the rails is free to move some 5 to 6 mm. (3/16″ to 1/4″) in order to compress the joint. In addition there must be room enough to get in the appliance used for compressing the joint.

Before making a weld of this kind, the first thing to do is prepare and dry the moulds. An extremely refractory sand must be used.

The rails are then held in the compressing appliance and their ends cleaned up by a special hand-operated milling machine. The piece of welding metal is then inserted between the rails heads. The two-piece mould is then put into place and the joints made tight with clay or liquid clay injected into the special channels provided.

The next stage is the pouring of the thermit. The crucible is carefully fitted over the mould and the joint is heated with a petrol blowpipe for about a quarter of an hour which makes it red hot.

During the heating the crucible is filled with thermit and the mixture for igniting it added. Ignition of the thermit, the reaction, piercing the crucible, and filling the mould takes about half a minute. After waiting a few minutes for the rail head to attain the welding temperature throughout its section, the joint is compressed and the welding is then completed.

As soon as the joint is quite cold, the moulds are removed, although in special cases this can be done sooner. The fin due to the compression of the joint is then machined off.

Welds have been made since 1925 on the main lines and secondary lines, in the open, on bridges and in tunnels. The welding of rails of different section known as transition joints deserves special mention. As a rule 15-m. (49′ 2 1/2″) rails are welded into 30-m. (98′ 5″) lengths. As a trial, lengths of up to 300 m. (984′) have been laid in the open without special fittings, i.e. with ordinary fish-plate joints at the ends.

About 360 000 thermit welds are now in existence on the Reichsbahn.

A few of the welds in the beginning were made by the two Companies : Elektro-Thermit G.m.b.h., *Berlin-Tempelhof*, Golditzstrasse, 37-39, and Aktien Gesellschaft fur Aluminotermische und Elektrische Schweissungen, Professor Dr. Hans Goldschmidt-Ingwer Block, *Berlin-Britz*, Graderstrasse, 60-72.

Now its staff has received the necessary instruction the Reichsbahn is making the welds with plant and welding metal supplied by these two firms.

2. *Electric resistance welding* is based on the fact that a small-diameter wire carrying an electric current becomes very hot, a fact that is a drawback when laying electric cables but which can be used with advantage in welding work. The rails to be united are quickly raised to welding temperature, pressed together, and welded. It is this simple butt-welding process which gave rise to electric fusion welding. The welding machine has two copper blocks carrying the rails to be welded, one acting as the stop against which the other butts when compressing the weld by hand wheel or motor.

To make a weld, the ends of the rails are brought very close together so that the current can pass freely from one to the other, and then are separated again. After doing this several times the ends are hot enough for the metal to begin to melt and this removes all irregularities on the surfaces to be welded. After this « *fusion* » operation the ends are pressed together and the scale formed is forced out on both sides of the weld in the form of a fin which is easily removed whilst hot.

On the Reichsbahn, since 1929, new and worn rails have been welded together to form long lengths. The whole of the welds have been carried out by Messrs. : Theodor Wuppermann G.m.b.H. *Leverkusen-Schlebusch* (near Cologne), Vereinigte Stahlwerke A. G. Hütte Ruhrort Meiderich, *Duisburg- Meiderich;* Bamag-Meguin A. G. *Butzbach* (Hessen), with welding machines supplied by the Allgemeine Elektrizitäts - Gesellschaft, *Berlin.*

The results obtained with the two welding methods can be considered as satisfactory as the number of breakages or cracks has been insignificant.

Whilst the Reichsbahn has not used *arc welding* because of the poor results obtained, the Belgian National Light Rys. Co., Göteborg-Boras & Alvesta Ry., Karlskrona-Växjö Ry., Swiss Federal Rys., and Royal Hungarian State Rys. are making trials of this method. Covered electrodes or electrodes of special materials are generally used. Gas welding has not been used so far, except experimentally by the Reichsbahn, Swiss Federal Rys. and Hungarian State Rys. No opinion can be expressed on its value as the trials are not yet completed. The *Swiss Federal Rys.* use special welding wire and 4 to 6-mm. (5/32″ to 1/4″) diameter bare wire.

The Railways who replied recommend *welding* for making long rails, for both *technical* and *financial* reasons. The chief advantages of the thermit process are the ease with which it can be used on the line, its reliability, and the good service the welds give. Resistance welding is used because of the quality of the weld, the good service it gives, and its moderate cost. Opinions vary in the case of arc welding. The Netherlands Rys. and Reichsbahn have found it unsatisfactory, the Hungarian State Rys. are using it experimentally, as a result of laboratory tests and its extensive use with good results on the Budapest tramways. As regards the reasons in favour of autogenous gas welding, the only tests of which we are aware are those being made by the Reichsbahn, Swiss Federal Rys. and Hungarian State Rys. and consequently no definite opinion can be expressed on this method. The Hungarian State Rys. think that as a result of satisfactory laboratory tests, this method also used by the Polish State Railways has a future before it.

The *inspection of the welds* as a whole usually consists in testing a percentage. The Reichsbahn examines 1 % of the welds in this way; the Danish State Rys. and Swiss Federal Rys. examine every single weld, the first visually.

Various methods are in use *for examining the individual welds.* As a general rule, the welds are examined, before adopting any particular method and during the trial period, by one or more test methods, the most usual being the bend test and the second the impact. Only 3 Administrations, the Belgian National Rys. Co., Deutsche Reichsbahn and Swiss Federal Rys. examine the texture, and only 4, the Belgian National Rys., Karlskrona-Växjö Ry., Deutsche Reichsbahn and Polisth State Rys. carry out tensile tests. Hardness tests (Brinell) are resorted to by 3 Railways (Belgian National, Reichsbahn and Polish State). The Swiss Federal Rys. and Hungarian State Rys. carry out fatigue bend tests. The Swiss Federal Rys. have ascertained by this means 70 % of the original tensile strength with thermit welding, and at least 80 % with resistance welding. Whilst some of the Administrations the Belgian National Rys. Co., Reichsbahn, Swiss Federal Rys., Hungarian State Rys. and Polish State Rys. use various methods for testing the selected welds, the Swedish State Rys. are satisfied with a bend test and the

Bergslagen Ry. and Göteborg-Boras-Alvesta Ry. with an impact test. A third group, the Belgian National Light Rys. Co., Netherlands Rys., Danish State Rys., Norwegian State Rys. and Austrian Federal Rys. do not consider it necessary to test the welds, provided the work has been prepared and carried out with care. The Reichsbahn does not specify tensile, impact, examination of texture, and other special tests before passing the welds, but only makes them from time to time to make sure that the work was done properly.

Minimum values for test results are only prescribed by three Administrations, Belgian National Rys. Co., Swedish State Rys. and Deutsche Reichsbahn, for certain tests. The Belgian National Rys. Co. deal with this question in great detail. They require a normal strength of 2 000 Kg.-M. (14 470 ft./lb.) (tup 500 kgr. = 1 100 lb.), height of fall 4 m. (13′ 1 1/2″), distance between supports 1.10 m. (3′ 7 5/16″). The Brinell hardness on the running surface should be the same at the weld as in the metal adjacent to it, and little different beyond the weld. Tensile tests on 13.8-mm. (35/64″) diameter test bars should give over 9 % elongation in the section of the weld at the middle of the test bar on a length of 100 mm. (3 15/16″) between marker points.

As regards the notched bar test, the test must give more than 1.5 kgr./cm^2 (21.3 lb. per sq. in.) at the weld and close to it. Micrographical examinations did not reveal any large overheated zone with a change in structure. The Swedish State Rys. require the tangent of the angle to be at least 0.15 to 0.20 in the bend test. The Reichsbahn specifies a deflection of at least 40 mm. (1 9/16″) on a length of 1 m. (3′ 3 3/8″) between supports ($\tan \alpha = \frac{40 \times 4}{1\,000} = 0.16$). So far the other Railways have not laid down any minima for the results of weld tests.

On *most of the Administrations* the welds are made by the railway staff. In isolated cases only, especially with electric welding and processes still under trial, is the welding done by contractors.

Thermit welding is usually done *on the spot* and rarely at special centres. *Electric welding* is carried out in the shops.

Amongst the *reasons given for welding rails* are : fewer joints, longer life of old rails, better riding of stock. In addition the increased length of rails reduces the stresses in the track and the rolling stock so that a reduction in the cost of maintenance both of the track and the rolling stock is to be expected. So far, of course, this reduction cannot be expressed in figures.

Most Administrations weld both new and old rails. The Netherlands Rys. only weld new rails, whereas the Göteborg-Boras & Alvesta Ry., Karlskrona-Växjö Ry., Swiss Federal Rys., Austrian Federal Rys., Hungarian State Rys. and Polish State Rys. weld old rails in order to extend their life.

As regards the *class of line on which the welded rails are laid,* the main lines run over by express trains are usually selected. The long bridges and tunnels take the second place for reasons of economy as the stresses set up in the bridges by the joints are eliminated. The Netherlands Railways use none but welded rails on their long bridges, and the Austrian Federal Railways use them mainly in tunnels and on bridges. The use of long rails in tunnels is obviously sound owing to the small variations in temperature. Old rails have been welded for considerable lengths on secondary lines and in sidings to lengthen the life of the rails for reasons of economy.

Table I below gives particulars of the *length of lines welded up to the present.*

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Length of lines we

Welding process.	ADMINI							
	Belgian National Rys. Co.	*Belgian Nat. Light Rys. Co.*	*Prince Henry Ry.*	*Netherlands Rys.*	*Danish State Rys.*	*Swedish State Rys.*	*Bergslagen Ry.*	*Göteborg-Boras-Alvesta Ry.*
a) Thermit welding	...	700 *(435)*	...	No data	350 *(217.5)*	...	...	5 *3.1)*
b) Resistance welding	150 *(93.2)*	...	...	...	...	236 *(146.7)*	30 *(18.6)*	
c) Electric butt-welding. . . .	...	...	...	...	...	...	...	
d) Arc welding of fish-plate edges.	...	250 *(155.3)*	...	...	...	...	...	...
e) Autogenous (gas) welding . . .	...	...	...	...	...	...	...	...
Total. . .	150 *(93.2)*	950 *(590.3)*	...	...	350 *(217.5)*	236 *(146.7)*	30 *(18.6)*	5 *(3.1)*

This table shows that the welding of rails has made great progress in a short time. It also shows that thermit welding is the most used up to date, and that resistance welding has only been used on about a third of the length of lines thermit welded. Arc welding is used much less than the two methods mentioned above, i.e. on only $\frac{1}{108}$th of the length of lines thermit welded. Arc-welding the edges of the fish plates has been introduced by the Belgian National Light Rys. Co. only, 1 250 km. (777 miles) of lines being welded in this way.

No numerical data has been supplied on the extent gas welding has been used, as this process is resorted to by only three Railways as an experiment.

The number of « Schweisstellen » in the questionnaire was intended to mean the number of joints welded but has been translated by « chantiers de soudure » (welding yards) in the French list of questions, so that most of the railways have entered the number of shops as the number of welds. As the number of welded joints increases as a greater number of rails are welded together into a long rail, and as the number of welded joints per kilometre of line is a function of the standard rail length, it is unfortunately impossible to make an approximate estimate of the number of welded joints on the different railway systems. On the Reichsbahn some 300 000 joints have been welded by the thermit process and some 150 000 by resistance welding.

On most railways, *rails of the same or different* sections *are welded together.* In the latter case, the thermit process is used, generally with complete satisfaction. Only the Belgian National Light

LE 1.

d, in km. *(in miles)*.

RATIONS.										
Karlskrona-Växjö Ry.	*Halmstad-Nässjö Ry.*	*Norwegian State Rys.*	*Deutsche Reichsbahn.*	*Swiss Federal Rys.*	*Austrian Federal Rys.*	*Hungarian State Rys.*	*Polish State Rys.*	Total.		
...	...	8 *(5)*	4 700 *(2 920)*	18 *(11.2)*	No data	2 *(1.2)* new rails 191*(118.7)* old rails	600 *(373)*	6 551 *(4 070.4)*	5 *(3.1)*	18 *(11.2)*
...	...	...	1 500 *(932)*			...	...	1 916 *(1 190.5)*		
25 *(15.5)*	...	...	...		...	...	...	25 *(15.5)*		
..	...	...	...		...	...	...	250 *(155.3)*		
...	...	...	...		...	...	...			
25 *(15.5)*	...	8 *(5)*	6 200 *(3 852)*	18 *(11.2)*	...	193 *(119.9)*	600 *(373)*	8 765 *(5 446)*		

Rys. Co. and the Karlskrona-Växjö Ry. have arc-welded such rails end to end. The Netherlands Rys., Swedish State Rys., Norwegian State Rys. and Swiss Federal Rys. so far have only welded together rails of the *same section.*

Table 2 below gives the year in which each railway began to weld rails.

TABLE 2.

Year each Railway started welding rails.

Railways	*Belgian Nat. Rys.*	*Belg. Nat. Light Rys.*	*Netherlands.*	*Danish State.*	*Swedish State.*	*Bergslagen.*	*Göteborg-Boras-Alvesta.*
Year.	1929	1910	1931	1929	1932	1929	1933
Railways	*Karlskrona-Växjö.*	*Norwegian State.*	*Reichsbahn.*	*Swiss Federal.*	*Austrian Federal.*	*Hungarian State.*	*Polish State.*
Year.	1928	1930	1924	1928	Thermit : 1927. Resistance : 1935.	Thermit : 1904, (experimental), 1927, (general). Arc welding : 1934 (experimental). Gas welding : 1935, (experimental).	1930

Generally speaking the railways intend to continue to weld rails and with one exception, on an extended scale. Whilst 9 Administrations expect to still improve the thermit process, almost as many (7) are in favour of extending the application of resistance welding. Four Railways intend to use electric-arc butt welding more generally, and one is extending the practice of arc-welding the edges of the fish plates. Three Administrations are considering the use of autogenous welding on a larger scale Practically everywhere the intention is to use any new processes which have given good technical and financial results under test.

Table 3 below gives particulars of the maximum axle loads, maximum speeds, smallest radii of curves, and maximum gross tonnage worked annually over welded sections.

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Maximum axle loads, speeds, smallest radii

Railways	*Belgian National Rys.*	*Belgian National Light Rys.*	*Netherlands Rys.*	*Danish State Rys.*	*Swedish State Rys.*	*Berg lage Ry.*
a) Maximum axle load, metr. (*Engl.*) tons	No restrictions.	10 (*9.8*)	20 (*19.7*)	20 (*19.7*)	18 (*17.7*)	18 (*17*
b) Maximum train speed, km. (*miles*)	»	60 (*37.3*)	100 (*62*)	120 (*75*)	90 (*56*)	100 (*6*
c) Smallest radius of curves, m. (*chains*)	»	18 (*59'*) ou electrified section; 30 (*1.5*) or exceptionally; 20 (*1*) on steam worked sections.	Only on straight section up to the present.	250 (*12.5*)	600 (*30*) for 90 km. (*56 miles*) per hour. 300 (*15*) for 60 km. (*37.3miles*) per hour.	700 (*3*
d) Annual gross tonnage, metric tons	»	1 500 000	11 000 000	4 000 000	...	...

The *sleepers at welded joints are generally spaced* as with fished joints. Some railways space then slightly closer. No Administration thinks it desirable to support the weld directly on a sleeper; on the contrary many express their opinion that the welded joint should be suspended.

As regards the *behaviour of the welds*, the replies agree that no irregularities in the running surface have been observed. As regards breakages, these have been divided up more or less equally in the weld itself and close to it in the metal that has been affected by the heat of the weld. The number of breakages as a percentage of the welds given in table 4 below will be found interesting.

This table shows that the number of breakages with the usual welding processes varies between the limits of 0 and 0.5 %, whereas the Belgian National Light Rys. Co. reports the very high percentage of 15 when the edges of the fish-plates are arc-welded.

Broken welds are dealt with in either of two ways. Usually the broken weld, temporarily fitted with fish-plates, is withdrawn from the track by cutting out a short section of the rail which is replaced by a suitable connecting piece of rail which is then welded at both ends. Some railways, fewer in number, replace the whole broken rail.

Only part of the Administrations replying to the questionnaire investigate the causes of breakage and continue the enquiry into the laboratory.

E 3.

rves, gross annual tonnage worked over welded rails.

Göteborg-Boras & lvesta Ry.	*Karls-krona-VäxjöRy.*	*Norwegian State Rys.*	*Deutsche Reichsbahn.*	*Swiss Federal Rys.*	*Austrian Federal Rys.*	*Hungarian State Rys.*	*Polish State Rys.*
14 (*13.8*)	13 (*12.8*)	18 (*17.7*)	20 (*19.7*)	20 (*19.7*)	20 (*19.7*)	17.5 (*17.2*) electr. locom. 16.14 (*15.9*) steam locom.	18.25 (*18.0*)
80 (*50*)	90 (*56*)	60 (*37.3*)	160 (*100*)	100 (*62*)	100 (*62*)	60 to 100 (*37.3* to *62*)	100 (*62*)
300 (*15*)	300 (*15*)	250 (*12.5*)	180 (*9*)	360 (*18*)	180 (*9*)	500 (*25*)	300 (*15*)
...	...	10 000 000	36 000 000	5 100 000	6 650 000	...	10 000 000

In thermit welding, the chief cause of failure is defective workmanship. The next cause, from the replies of the Austrian Federal Rys. and Hungarian State Rys. is the bolt holes in the fish-plates which are very harmful owing to the fact that fine cracks which start in them often end in breakage. No failure may be ascribed to a defective weld. Breakages with thermit and arc welding are rarely due to defective metal in the rail, but are more frequent with resistance welding. The Belgian National Light Rys. Co. attributes the many breakages, when the edges of the fish-plates are arc-welded, to the fact that so far there is no reliable method of doing this work. Apart from the above causes if the formation is bad, breakages are probable even if the welds are well made.

The *cost of welding by the different processes* depends on local conditions and the traffic as well as on the rates

TABLE 4.

ADMINISTRATIONS.	Number of breakages, %.		
Belgian National Rys. Co.	No breakage. The result is not yet definite, resistance welding having been introduced about the middle of 1935 only.		
Belgian National Light Rys. Co.	Thermit welding : 0.5 %	Arc welding the edges of the fishplates : 15 %.	
Netherlands Rys.	No breakages.		
Danish State Rys.	0.015 %.		
Royal Swedish State Rys.	Year.	Length of welded track	Breakages in the year.
	1932	44 km *(27.3 miles)*	7
	1933	81 km *(50.3 miles)*	5
	1934	54.5 km. *(33.9 miles)*	3
	1935	56 km. *(34.8 miles)*	8
Bergslagen Ry.	0.3 %		
Göteborg-Boras & Alvesta Ry.	No breakages.		
Karlskrona-Växjö Ry.	No breakages.		
Norwegian State Ry.	0.5 %.		
Deutsche Reichsbahn	Thermit 0.14 %.	Resistance welding 0.02 %.	
Swiss Federal Rys.	No breakages.		
Austrian Federal Rys.	0.5 %.		
Royal Hungarian State Rys.	0.0715 %.		
Polish State Rys.	About 1.5 %.		

of pay in force in the country concerned.

The figures given are as follows :

Belgian National Rys. Co. — For one resistance weld : 15 fr.

Belgian National Light Rys. Co. — For one thermit weld : 275 fr. for a 50 kgr./m. (100.8 lb. per yd.) grooved rail;

250 fr. for a 32 kgr./m. (64.5 lb. per yd.) flat-footed rail;

For one joint arc-welded along the edges of the fish plates :

75 fr. for a 50 kgr./m. (100.8 lb. per yd.) grooved rail;

60 fr. for a 32 kgr./m. (64.5 lb. per yd.) flat-footed rail.

Netherlands Rys. — Consider the expenditure cannot be compared.

Danish State Rys. — About 30 crowns per thermit weld.

Swedish State Rys. — 3.5 crowns for a resistance weld.

Bergslagen Ry. — For an end-to-end resistance weld, 7 crowns.

Göteborg-Boras & Alvesta Ry. — For a thermit weld, 64 Swedish crowns; for an end-to-end arc-weld, 12 Swedish crowns.

Karlskrona-Växjö Ry. — For a single weld according to the way made, 9 Swedish crowns.

Norwegian State Rys. — For a thermit weld, 32 Norwegian crowns.

Deutsche Reichsbahn. — For a thermit weld, 20 to 25 Rm.; a resistance weld, about

10 Rm. (including cost of sending the rails to the works).

Swiss Federal Rys. — For a thermit weld, about 25 Swiss fr.; a resistance weld, about 18 fr.; an autogenous weld, about 12 fr.

Hungarian State Rys. — For a thermit weld by the railway staff of old 42.8 kgr./m. (86.2 lb. per yd.) rail, 17.32 pengoes; of old 34.5 kgr./m. (69.5 lb. per yd.) rail, 15.56 pengoes; of new 44.3 kgr./m. (89.3 lb. per yd.) rail, 18.78 pengoes; of new 48.3 kgr./m. (97.3 lb. per yd.) rail, 19.48 pengoes; per arc (butt) weld by the « Katona » process, by contract, per new 44.3 kgr./m. (89.3 lb. per yd.) rail, 22.91 pengoes; per autogenous weld by the « Tulac » process, by contract, per old 34.5 kgr./m. (69.5 lb. per yd.) rail, 16.00 pengoes.

Polish State Rys. — Per thermit weld, about 35 zloty.

The *financial value* of welding is recognised almost universally. The Belgian National Rys. Co. points out that the cost of a welded joint is less than half that of a fished joint, and in addition the maintainance cost of the fished joint is eliminated. The Swiss Federal Rys. estimate that the cost of the weld will be repaid by the saving in permanent-way maintenance through the fewer joints. The Austrian Federal Rys. find resistance welding very economical. This opinion is confirmed by other Administrations, according to whom resistance- and arc welding are cheaper than thermit welding, not only in the trials, but also when the cost of carrying the rails to and from the concentration points of the shop is included.

The Netherlands Rys. who only use thermit welding for rails on long bridges considers the reduced cost as being of secondary importance when compared to the advantage resulting from the lower stresses in the bridges. If it is admitted that the use of welded rails reduces maintenance costs and lengthens the life of the equipment, then such welding does give, all things considered good economic results.

The total length of rails welded together depends on the length of the individual rails and the number welded together to make a long rail. On open lines long rails composed of two to four rails welded together are used as a rule. On bridges much longer rails are used, the total length being 150 to 250 m. (492′ to 820′). In tunnels some Railways use welded rails 50 to 100 m. (164′ to 328′) long, whilst others, owing of the small temperature changes in tunnels, weld the rails into very long lengths (up to 2 000 m. = 6 560′).

Table 5 below gives the total lengths of welded rails on the different railway systems.

As regards the standard gaps at the joints of long lengths of welded rails for a rail temperature of 10° C. (50° F.) most of the Railways sent data, summarised in table 6, which can be compared.

This table shows that for a rail temperature of 10° C. (50° F.) the following are the relations between the length of the rails and the gap at the joint :

Length of rails.	*Gap at joints.*
18.40 to 22.40 m. *(60′ 4 7/16″ to 73′ 6″)*	7 mm. *(9/32″)*
23 to 24 m. *(75′ 5 1/4″ to 78′ 9″)*	8 to 10 mm. *(5/16″ to 3/8″)*
28.8 to 30 m. *(94′ 6″ to 98′ 1 5/8″)*	4 to 11 mm. *(5/32″ to 7/16″)*
32 to 33 m. *(105′ to 108′ 3 1/4″)*	9.5 mm. *(25/64″)*
35 m. *(114′ 10″)*	8 mm. *(5/16″)*
54 m. *(177′ 2″)*	10 mm. *(3/8″)*
60 m. *(196′ 10″)*	8 to 22 mm. *(5/16″ to 7/8″)*

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Total lengths of welded r

Railways . . .	*Belgian National Rys. Co.*	*Belgian National Light Rys. Co.*	*Netherlands Rys.*	*Danish State Rys.*	*Swedish State Rys.*	*Bergsla Ry.*
a) on open lines .	...	54 m. (*177' 2"*) 72 m. (*236' 2"*) where there are no sharp curves.	...	30 m. (*98' 5"*) exceptionally 60 m. (*196' 10"*)	18.40 m. and 22.40 m. (*60'4 1/2"* and (*73' 6"*)	28.8 m. (*94* 37.5 m. (*1* 40 m. (*131'*
b) on bridges . .	35 m. (*114' 10"*) and 54 m. (*177' 2"*)	...	According to circumstances up to 200 m. (*656' 2"*)	Up to 245 m. (*804'*)	...	...
c) in tunnels . .	54 m. (*177' 2"*) to 108 m. (*354' 4"*)	...	...	Up to 1 [illegible]00 m. (*4 265'*)	...	...

T

Normal gap between welded rails of different t

RAILWAYS		*Belgian National Rys. Co.*		*Danish State Rys.*	*Swedish State Rys.*	*Bergslagen Ry.*	*Göteborg-Borås-Alvesta Ry.*	*Norwegian State Rys.*
Rail lengths . .	m.	35	54	30	18.4 22 4	28.8	23	30
	ft. in.	*114' 10"*	*177' 2"*	*98' 5"*	*60' 4 1/2"* *73' 6"*	*94' 6"*	*75' 5"*	*98' 5"*
Joint gaps . .	mm.	8	10	7	7	11	10	0
	inches	*5/16"*	*3/8"*	*9/32"*	*9 32"*	*7/16"*	*3/8"*	*0"*

The different gap widths at the joints for almost equal total lengths show that when these widths were decided upon, the local atmospheric conditions were taken into account.

Generally speaking, three groups are to be distinguished from this point of view :

1. Particularly high summer temperatures, and moderate winter temperatures.

2. Average summer and winter temperatures.

3. Moderate summer temperatures, particularly low winter temperatures.

The records kept on the Reichsbahn for some 14 years give a maximum difference between summer and winter temperatures of 80° C. (144° F.) and a minimum of 70° C. (122° F.). The gap

E 5.

the different Railways.

Göteborg-Boras-lvesta Ry.	*Karlskrona-Vaxjö. Ry.*	*Norwegian State Rys.*	*Deutsche Reichsbahn*	*Swiss Federal Rys.*	*Austrian Federal Rys.*	*Hungarian State Rys.*	*Polish State Rys.*
Electric arc tt - welding m. (*75' 5"*)	Up to 22.89 m. (*75' 1"*)	30 m. and 60 m. (*98' 5"*) and (*196' 10"*)	30 m. and 60 m. (*98' 5"*) and (*196' 10"*)	Up to 33 m. (*108' 3"*)	On open lines 30 m. (*98' 5"*) In sidings up to 56 m. (*183' 8"*)	22 m. (*72' 2"*) 24 m. (*78' 9"*) 32 m. (*105'*) 33 m. (*108' 3"*)	Up to 60 m. (*196' 10"*)
hermit welding up to 0 m. (*1 476'*)	...	...	Up to the span of the bridges	Up to 180 m. (*590' 6"*)	Up to 145 m. (*475' 8"*)	24 m. (*78' 9"*)	...
...	...	90 m. (*295' 3"*)	Up to 2 000 m. (*6 562'*)	Up to 90 m. (*295' 3"*)	Up to 100 m. (*328'*)	48 m. (*157' 5"*)	...

E 6.

ngths, for a rail temperature of 10° C. (50° F.).

Deutsche Reichsbahn		*Austrian Federal Rys.*	*Swiss Federal Rys.*		*Hungarian State Rys.*			*Polish State Rys.*
30	60	30	In the open 33	In tunnels 90	20 to 22	24	32 to 33	60
98' 5"	*196' 10"*	*98' 5"*	*108' 3"*	*295' 3"*	*65' 7" to 72' 2"*	*78' 9"*	*105' to 108' 3"*	*196' 10"*
4 to 8	8 to 16	7 to 9	10	9	7	8 to 10	9.5	Up to 22
5/32" to 5/16"	*5/16" to 5/8"*	*9/32" to 23/64"*	*3/8"*	*23/64"*	*9/32"*	*5/16" to 3/8"*	*13/32"*	Up to *7/8"*
			Compression devices on bridges.					

at the joints is such as to prevent the track getting out of order in very high summer temperatures, and in winter at particularly low temperatures bending or breaking the fish-plate bolts. The relation between the length of the rails and the gap at the joint shows how divided opinions are on this point. The difference between the play for the 28.80 to 30-m. (94′6″ to 98′ 1 5/8″) rails will be noted. The Bergslagen Railway reports a gap of 11 mm. (7/16″), and on the Norwegian State Railways (0 mm.). It would be interesting to know what results were obtained, with the gaps provided, at high and low temperatures.

As regards the joints between the welded rails, *ordinary fished joints are used almost exclusively.* The Hungarian State Rys. only uses expansion joints of the « Csillèry » type only in the case of 120-m. (393′ 8″) lengths of welded rails.

According to the information supplied by the Railways, *special expansion devices* are only used on bridges and other structures. The Netherlands Rys. who use thermit welds for rail lengths up to 200 m. (656′) only on long bridges do not consider such devices necessary. On the other hand the Swiss Federal Rys. use them when the length exceeds 60 m. (196′ 10″). The following table gives the lengths of some of these devices.

RAILWAYS.		*Danish State.*	*Reichsbahn.*	*Swiss Federal.*	*Hungarian State.*
Length.	mm.	up to 440	100. 200 and 300	60 and 200	80 and 120
	in.	up to 27 5/16″	3 15/16″, 7 7/8″ and 11 13/16″	2 3/8″ and 7 7/8″	3 5/32″and 4 3/4″

Each company uses its own design with the exception of the Hungarian State Rys. who employ the Csillèry device.

Several companies have taken *special precautions to prevent the track getting out of shape.* The Netherlands Rys. anchor every third sleeper to the stringers on bridges. The Swedish State Rys. prevent the track from buckling but give no special information on how it is anchored. The Göteborg-Boras & Alvesta Ry. fits short lengths of rail to the bottom of the sleepers to make the track more rigid transversely. On the Swiss Federal Rys.' bridges the sleepers are fastened to the flooring. In order to prevent creep the Karlskrona-Växjö Ry. makes the bed of gravel ballast wider. The Deutsche Reichsbahn uses in some curves special safety gaps on the wood sleepers. The Hungarian State Rys. recommend the use of ribbed bearing plates to give greater transverse strength. When the rails are welded without any gap they are packed with *broken stone* on the Belgian National Light Rys. Co. and *gravel* on the Göteborg-Boras & Alvesta Ry. The Belgian National Light Rys. Co. ballasts the lines according to the kind of track and the radius of the curves (radii down to 18 m. = 59 5/8″). The Deutsche Reichsbahn ballasts just over the foot of the rails. No railway, however, is satisfied with simply ballasting over the sleepers. The Hungarian State Rys. think the track is strengthened against deformation by increasing the layer of ballast to between 34 and 40 cm. (13 3/8″ and 15 3/4″), whilst on electrified lines they are considering a depth of 50 cm. (1′ 7 11/16″). It would be interesting to know whether the different precautions taken to prevent deformation of the track have been really effective, or if in spite of them, deformation still occurred.

When *ballasting track with welded rails* broken stone of 3 to 7 cm. (1 3/16″ to 2 3/4″) size is chiefly used. The Belgian National Rys. Co. uses in addition small quarry chippings of 1 to 5 cm. (3/8′ to 2″) size, whilst the Norwegian State Rys. use nothing but quarry chippings of 2 to 5 cm. (3/4″ to 2″) size. The Swedish State, Bergslagen, Göteborg-Boras and Karlskrona-Växjö Railways only use gravel. Where local conditions do not make the use of gravel compulsory, the general tendency is to use broken stone or at least quarry chippings, in order to increase the friction between the sleepers and the ballast.

The Danish State Rys., Deutsche Reichsbahn and Hungarian State Rys. have carried out *measurements in connection with the effect of temperature changes* on the expansion and contraction of long welded rails. The Karlskrona-Växjö Ry., Swiss Federal Rys. and Austrian Federal Rys. only made such measurements during the experimental period. The usefulness of such measurements is that they enable the difference between the laying gap to be compared with the actual gap at the joint. This latter, which varies under the frictional action of the fish-plates, of the rail on the sleepers, and of the sleepers on the ballast, generally differs from the laying gap after a rise or fall in temperature, the play left when laying the rails in the unstressed condition at the same rail temperature being called the laying gap. The frictional resistances cause the joint gap to become greater than the laying gap when the temperature rises and smaller when the temperature falls. When checking the joint gap, the important thing to ascertain is the uniformity of the gaps. On gradients, when the play is found to be smaller at the bottom of the gradient and larger at the top, the rail may be considered to have crept. To avoid excessive pressures, the creep of the welded rails should be prevented by anticreep devices.

B. — Application of welding to the construction and repair of permanent way fittings (sleepers and small parts).

Up to the present the Deutsche Reichsbahn, Hungarian State Rys. and Polish State Rys. are the only Administrations *repairing old metal sleepers by welding.* The Belgian National Rys. Co. has only used metal sleepers since 1930, so that the question of repairs has not yet arisen.

On the Reichsbahn the sound middle part is cut out of old metal sleepers and arc-welded up into new sleepers. So far fractures have not been welded up nor new bearing plates welded onto the sleepers. The Hungarian State Rys. have only used metal sleepers in running roads since 1931 and, therefore, have only been welding the old metal sleepers in sidings since that date. When this is done the cracks are welded up and new bearing plates welded on or the cracked bearing plates are cut out and replaced by welding new ones in position. The Polish State Rys., which have a large number of metal sleepers in use, have had satisfactory results from welding old metal sleepers.

Welding processes for repair work. — The Reichsbahn uses resistance welding alone, whereas the Royal Hungarian State Rys. and Polish State Rys. use both arc and gas welding in this connection. The Reichsbahn prefers resistance welding as it has given good results from every point of view. The Royal Hungarian State Rys. report that gas welding has the advantage of speed and cheapness, whilst arc welding gives the better results. The Polish State Rys. only use these two methods of welding for lack of something better.

The date welding was first applied to sleepers is still quite recent. The Reichsbahn started in 1923 to test such welds, whilst the Hungarian State Rys. have only welded sleepers since 1928 and the Polish State Rys. since 1929. The time is too short and the use too restricted for any opinion based on the experience of the different companies to be expressed on the best method of repairing metal sleepers, and on the welding process to apply.

The Reichsbahn alone so far *tests the welded sleepers,* using the bend test for the purpose. The Hungarian State Rys. consider the testing of welded metal sleepers of no value. The Polish State Rys. have not inspected sleepers of this kind so far.

The Railways unanimously agree that *welded metal sleepers have given good results.*

The Reichsbahn has *effected savings by repairing old metal sleepers,* when the costs of welding and accessory costs and the receipts from scrapped materials are taken into account. The Hungarian State Rys. find savings are effected by repairing old sleepers under points and crossings, and the Polish State Rys. think that the savings are chiefly effected on these parts.

Welding is also used, though in isolated cases only, *to repair other permanent way equipment,* such as fish-plates, bearing plates, and parts of points and crossings.

Only a few Railways *weld* bearing plates or other fastenings *on to new metal sleepers.* This procedure is only used by the Deutsche Reichsbahn and Hungarian State Rys. on the running lines, whereas the Deutsche Reichsbahn, Austrian Federal Rys. and Hungarian State Rys. weld together parts in points and crossings. The Austrian Federal Rys. only use welding in connection with the slide chairs. The Polish State Rys. have only made a few experiments of this kind.

Continuous electric welding is used by the Deutsche Reichsbahn, Austrian Federal Rys. and Polish State Rys.;

continuous gas welding by the Polish State Rys.; and

electric spot welding by the Hungarian State Rys.

The Belgian National Rys. Co. leaves the selection of the method of welding new metal sleepers to the maker. It specifies, however, the conditions of manufacture and inspection of sleepers, and accessory fittings, the guarantee and responsibility of the supplier; very detailed prescriptions are laid down in the « Technical Specifications A-10-32 for metal sleepers with welded bearing plates ».

The *kind of electrode* used with the different welding methods differs from one railway to another.

Bare electrodes are used by the :

Deutsche Reichsbahn for continuous electric welding;

Polish State Rys. for continuous gas welding;

Royal Hungarian State Rys. for spot welding.

Coated electrodes are used by the :

Polish State Rys. for continuous electric welding;

Hungarian State Rys. for spot welding.

Special electrodes are used by the :

Austrian Federal Rys. for continuous electric welding.

Hungarian State Rys. for spot welding.

At present the Hungarian State Rys. are only using coated electrodes and special electrodes experimentally. The cost of electrodes has a great influence on the total cost of the weld so that the selection of the most suitable electrode is an important matter. With ordinary bare electrodes joints can be welded which will satisfy the most rigorous conditions.

Welding bearing plates or other railway fastenings to the sleepers started at the following dates :

Railways . .	*Belgian National Rys. Co.*	*Deutsche Reichsbahn.*	*Austrian Federal Rys.*	*Hungarian State Rys.*
Year	1930	1926, as a trial; 1928, on a large scale.	1935	1928, sleepers under points; 1932, slide chairs; 1934, ribbed bearing plates.

The Belgian National Rys. Co. welds all the fittings to new metal sleepers and the Austrian Federal Rys. weld the slide chairs to all modern points and crossings. The Reichsbahn uses welding in this way on a large scale. The Hungarian State Rys. have been welding for some time many ribbed bearing plates besides the slide chairs.

Different methods are used to *inspect* the welded parts. The Belgian National Rys. Co. specifies very detailed inspection, including impact tests, bend tests, tensile tests, and metallographical analysis. The Deutsche Reichsbahn subjects welded parts to impact and bend tests and examines the joints as to the way the parts are connected together and the depth of penetration. On the Austrian Federal Rys. the welds are only examined superficially as a rule, though in certain special cases the welds are machined and examined under the microscope to see the quality of the welds (slag inclusions, etc.). This Administration has also reserved the right to examine 1 out of 500 sleepers by X-rays. The Hungarian State Rys. subject the welded parts to impact and bend tests.

In their replies the Railways agree that welds in the construction and maintenance of permanent-way equipment have behaved well as a rule.

Welding bearing plates and other rail festenings to the sleepers has generally speaking been found *economical.* The Austrian Federal Rys. have found it is cheaper to weld slide chairs than to rivet them, whilst according to the Hungarian State Rys. the cost of repairs is less owing to the sole plates or slide chairs being solidly connected to the sleepers.

C. — Building up by welding.

The two preceding chapters, A and B, have dealt with the application of welding in assembling parts of the track together, i.e. the rails together, then welding together parts of the sleepers, and finally for welding the bearing plates to the metal sleepers. *Building up by welding provides a means for restoring the original section of the rails, points and crossings, by adding metal of sufficient hardness at the worn points.*

In this connection it may be interesting to retrace the evolution of this process on the Reichsbahn. This administration started in 1926 to build up worn wing rails and noses. Arc welding was used at first, and gas welding since 1934. The work was done both in the shop and on the line, i.e. without taking the points and crossings apart. As gas welding can be used at any point on the line as it requires no external supply of current and is therefore not dependent on shops and stations, worn rail ends, worn running surface (flaking), and sections worn by wheels slipping have all been built up by gas welding. All the tests made with the two welding processes have given satisfactory results and are being continued.

The replies show that building up by welding has been adopted by the different Administrations as follows :

Running surface of the rails : Belgian National Light Rys. Co., Deutsche Reichsbahn and Polish State Rys.

Rail ends : Belgian National Light Rys. Co., Halmstad-Nässjö Ry., Deutsche Reichsbahn, Swiss Federal Rys. and Polish State Rys.

Crossing noses : Belgian National Rys. Co., Belgian National Light Rys. Co., Prince Henry Ry., Netherlands Rys., Bergslagen Ry., Deutsche Reichsbahn, Hungarian State Rys., Swiss Federal Rys. and Polish State Rys.

Wing rails : Belgian National Rys. Co., Belgian National Light Rys. Co., Prince Henry Ry., Netherlands Rys., Bergslagen Ry., Deutsche Reichsbahn and Polish State Rys.

Point blades : Belgian National Rys. Co., Belgian National Light Rys. Co., Bergslagen

Ry., Deutsche Reichsbahn and Polish State Rys.

Part of the above applications are only experimental. The Göteborg-Boras & Alvesta Ry., Norwegian State Rys. and Austrian Federal Rys. have started to build up worn parts by welding as an experiment. The Danish State Rys. have given up repairing blades, connecting rails and crossing noses by arc welding owing to breakages or because the cost of the repair was too high relatively to that of new parts. The information received shows that crossing noses, and wing rails are the details most generally repaired by welding, followed by blades and rail ends. The running surface of the rails has only been repaired so far to a restricted extent, probably because damage through slipping is relatively unusual.

It is possible that the inner rail on curves when much worn on the sides may be built up by welding.

As regards the welding method used for building up, 7 Railways use arc welding, and 8 gas welding. It is not possible therefore to say which of these processes is the better for building up.

As regards the welding rods, the following information has been supplied :

Six Administrations use bare rods;

Seven Administrations use coated rods;

Four Administrations use rods of special materials, one of them as a trial.

The Prince Henry Ry. uses bare 270 Brinell rod with gas welding. The Deutsche Reichsbahn uses in addition to the bare and coated electrodes, a special electrode of 200 to 250 Brinell for arc and autogenous welding. The Netherlands Rys. give the following analysis of the weld metal deposited by gas welding :

P = 0.022
Mn = 0.85
Cr = 1.10
C = 0.37
S = 0.012
Si = 0.49
Ni = 0.15

With two exceptions no minimum Brinell hardness is specified by parts built up by welding. The Netherlands Rys. do not specify any minimum hardness but add that after welding the hardness is 250 to 300 Brinell. The Deutsche Reichsbahn specifies a 200 Brinell hardness and the Royal Hungarian State Rys. 300 to 350.

Five Railways are experimentally building up worn parts in situ, and three carry out the welding in the shops. Four Railways weld according to circumstances in the track or in the shop. The place the work is done is governed by the type of part to be repaired and the welding process used.

Building up by welding is nearly always done *by railway staff*. By only three Administrations is this work contracted out, on one of them experimentally, however.

As to the *results obtained from building up by welding*, five Administrations state the welded parts wear no more quickly than the adjacent parts of the rail, though two other Railways contradict this. One Railway finds little difference in wear and another does not consider the results so far obtained altogether satisfactory. On five Railways the built-up parts show no signs of disintegration so far but they do so on two Railways. Four of the Companies report disintegration of welds in isolated cases and one points out that crossings repaired in this way have flaked off under the blows from the wheels. Taken as a whole the result of building up worn parts by welding *cannot so far be considered satisfactory*. The reasons why there is still in many cases insufficient intimate union between the rails or points and crossings and the added metal should therefore be investigated. The question will be to ascertain the quality of the metal, of the part to be welded and of the electrode, and to decide where and how the work is to be done in order to produce a detail as good as a new part with the minimum of cost.

Although in various cases the results are still not entirely satisfactory, six Administrations agree on the *economic value of building up by welding.* Four Railways expect to obtain savings as soon as the trials are further advanced and more experience has been acquired of the method. One Company considers that building up by welding is still too expensive and consequently less economical, as the weld is less durable than the original part.

Building up by welding is of recent introduction as the following dates show :

Railways.	*Belgian National Light Rys Co.*	*Prince Henry Ry.*	*Netherlands Rys.*	*Bergslagen Ry.*	*Halmstad-Nässjö Ry.*	*Deutsche Reichsbahn.*	*Swiss Federal Rys.*	*Hungarian State Rys.*	*Polish State Rys.*
Year introduced.	1921	1935	1932	1932	1935 (Autumn)	1926	1928	1928, and on a larger scale in 1932.	1930

Building up by welding is not as a rule *applied* on a large scale, as almost all the Railways are carrying out further tests to cheapen the operation as much as possible, and sufficient data on the results is still lacking, owing to the short time the welded parts have been in service. The Polish State Rys. alone builds up by welding on a large scale.

The intention in almost all cases is to *extend the building up by welding,* especially as regards crossing noses and wing rails. All the Administrations using this method intend to continue to do so, six absolutely, and the others to a moderate extent, depending on the results of further tests.

Building up worn parts is the latest application of welding to permanent-way work. As the average time since it was first used is only five years, the matter is still in the development stage. Further trials will have to be made before the method of building up worn parts by welding can be put on scientific and economic lines.

D. — **Summary.**

Welding at present is in use in permanent-way work for :

Joining ordinary rails together to obtain long rails;

Assembling serviceable parts of old metal sleepers;

Welding bearing plates and slide chairs onto metal sleepers; and

Reconditioning worn running surfaces.

Long rails up to the present are usually obtained by thermit welding, the most widely used process. The operations are simple, and can be carried out in situ. The process is reliable and gives goods results in service. Rails of different section can be welded together easily by this process.

The experience so far available with electric resistance welding — although it was used on a smaller scale at the beginning — indicates a great future for this process because of the quality of the welds, the good results, and the particularly low cost. It is true that, as a rule, it can only be carried out in the shops, as the kind of current required cannot be produced under normal conditions on the line. Everything goes to show, however, that even it the cost of transport of the rails from and to the shops or other centres is taken into account, resistance welding will be cheaper than thermit.

Opinions are divided on the advantages of arc-welding the rails end to end to form long rails, and further experiments will have to be made to clear up this point.

Autogenous (gas) welding is resorted to at present experimentally only and on a small scale for joining rails together, so that it is still impossible to state how far it is suitable for this purpose.

Only one Railway has adopted the method of arc-welding the edges of the fish-plates. Compared with the other welding processes it has shown a high percentage of breakages.

Opinions are still much divided in respect of the play at the joints or more exactly the gap to be left when laying rails according to the temperature. In this matter the climatic conditions undoubtedly play a vital part. However, the width of the gap left when laying rails at a given temperature is of capital importance as regards the safety of the track laid with long rails. The gap must be so fixed that in summer, under exceptionally high temperatures, the track will not get out of shape, and in winter, at very low temperatures, the fish-plate bolts will not bend nor break. There is such variation in the gap widths prescribed by the different Railways for the same rail temperature that the results obtained at maximum and minimum temperatures with these gaps should be made known.

Besides the exact calculation of the play to be left for expansion, the second thing required is to see what special precautions have to be taken to prevent the track getting out of shape. Opinion is divided on this point too. Only one Railway bolts down the track to prevent vertical movements. Some Administrations take steps to increase the transverse rigidity of the track, the methods used being the following :

Fitting short lengths of rails to the bottom of the sleepers;

Cross-bracing the wooden sleepers;

A wider bed of ballast;

A greater depth of the ballast;

Packing the welded track without play with ballast on a level with the rail head.

It would be interesting to know if these steps have prevented the track getting out of shape or if deformation has nonetheless occurred.

The financial value of welding for making very long rails is universally recognised. Reducing the number of joints saves the costs of maintaining the eliminated fished joints, and the service life of the rails welded into long lengths is increased. The bridges are not so highly stressed when longer rails are used and maintenance work is reduced. The vehicles run more steadily and this again means lower repairs to rolling-stock and track maintenance costs.

In view of the technical and financial results obtained, the Railways intend to go on using long welded rails in the track and to perfecting the welding processes.

Welding is also used to *assemble serviceable parts of old metal sleepers* and make in this way either sleepers or foundation plates for points and crossings. The processes used are electric resistance welding, arc-welding of the rails end to end (butt welding) and autogenous (gas) welding. This method of dealing with the sleepers is too recent for any opinion to be expressed as to the best kind of reconditioning work or welding process to be used to this end.

The welded sleepers have behaved well so far and are cheaper than new ones.

Welding has conquered another field of application : *the welding of sole plates and slide chairs onto the metal sleepers.* Electric and gas fillet welding and electric spot welding are used for this class of work. The total cost depends on the welding process, the type of electrode, and the kind of current. The welds made so far have been satisfactory from a technical point of view. They also proved economical, as the rigid connection of the bearing plates or slide chairs with the metal sleepers has eliminated the maintenance costs due to the play between the two parts.

The *section of worn rails* can be *restored by welding* in sufficiently hard metal at the points struck by the wheels. This building-up is applied first of all to the noses of crossings and to the wing rails, and secondly to the point tongues and to the ends of rails. Arc and gas welding are the processes so far used. As a rule, the results are not yet considered entirely satisfactory, this kind of welding being still in the experimental stage. The texture of the metal in the part to be built up, the welding metal, the place where the work should be carried out and the way it should be done are points which still have to be investigated, in order to obtain a repaired part giving full satisfaction, technically and economically, and having the same life in service as a new part. Further and lasting tests are still required.

The present position is that the application of welding to permanent-way work has made so much progress technically and shows such financial savings that the railways have every interest in improving the different processes and extending their application.

[625. 113]

Reverse curves without any intermediate straight length,

by Dr. E. FEYL, Zentralinspektor, Vienna.

In order to fight road competition successfully, the railway must increase the speed of the trains to the greatest possible extent. However, this increase must not be reached at the expense of safety or smooth running. These conditions can be met to a large extent by improving the rolling stock and the track.

Running through reverse curves with short straight sections between the transitions is particularly difficult (fig. 1). Before the running speed can be increased at such places, the layout must be modified. Some Administrations try to do away with these short intermediate straight lengths and hope thereby to ensure the vehicles travelling steadily from one curve to the other. This method also offers an opportunity to reduce the cant gradients (superelevation ramps) which also tends to improve the running.

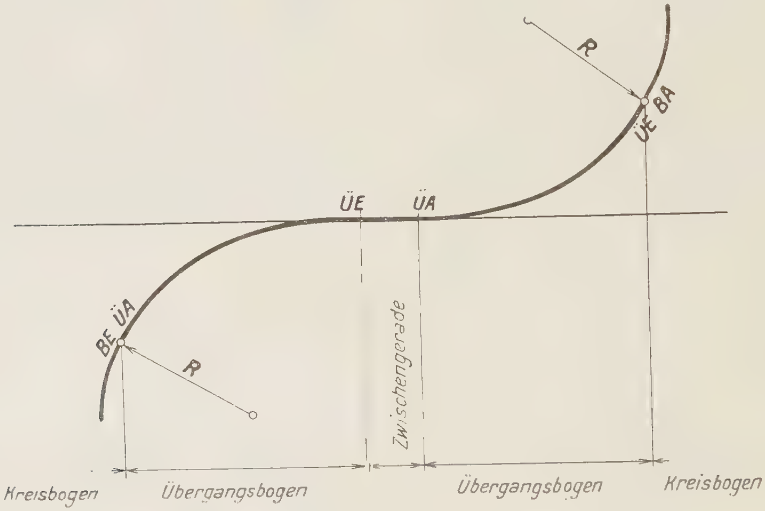


Fig. 1.

Note. — Kreisbogen = circular curve. — Übergangsbogen = transition curve. — Zwischengerade = intermediate straight section.

Only the passengers can decide whether a carriage runs comfortably or not, and consequently only their feelings can be taken as the criterion from which to judge whether an alteration has effected an improvement or not.

When travelling through a curve the human body is affected mainly by two forces : the force of gravity and the centrifugal force. The component G' of the force of gravity G, acting in parallel to the floor of the vehicle, tends to force the body inwards (fig. 2). Owing to the difference in level of the rails due to the cant (superelevation), at each cross section the floor of the vehicle has a definite inclination to the horizontal. The body is also acted upon by the centrifugal force F (the component F' is parallel to the floor) which tends (fig. 2) to throw it aside. The component F' of the centrifugal force is as a rule greater than that of the gravity G', so that the body is pushed outwards by the force

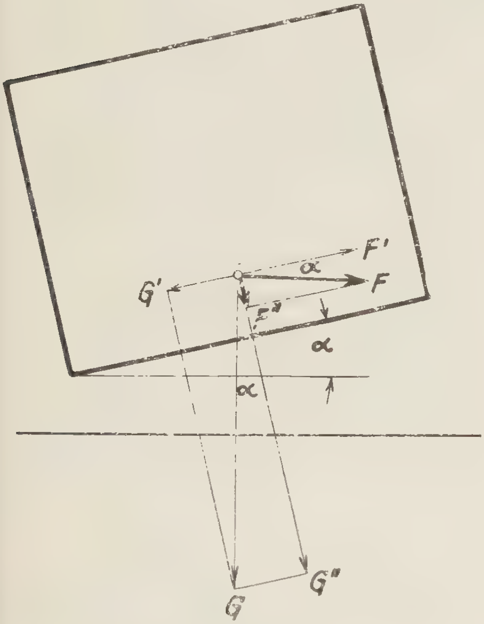


Fig. 2.

$$P = F' - G'$$

But

$$F' = F \cos \alpha$$

and

$$G' = G \sin \alpha.$$

Whence :

$$P = F \cos \alpha - G \sin \alpha.$$

As the angle α is very small, cos α can be taken as equal to 1. If furthermore the force be expressed by the product of the mass by the acceleration we get the following relation

$$mb = m\beta - mg \sin \alpha$$

or

$$b = \beta - g \sin \alpha \quad . \quad . \quad . \quad (1)$$

in which b = the resulting acceleration,
β = the acceleration due to the centrifugal force,
g = the acceleration due to gravity.

The passenger finds the acceleration unpleasant when it exceeds a certain rate or when the rate of increase in acceleration in unit time is too high. Besides the acceleration the increase in the acceleration in unit time must be taken into account. If this value be represented by Ψ, we get

$$\Psi = \frac{db}{dt} = \frac{d\beta}{dt} - g \frac{d \sin \alpha}{dt}.$$

This expression can also be written :

$$\Psi = \frac{d\beta}{dx} \cdot \frac{dx}{dt} - g \frac{d \sin \alpha}{dx} \cdot \frac{dx}{dt}.$$

But as

$$\frac{dx}{dt} = v$$

(v = speed),

we get

$$\Psi = \left(\frac{d\beta}{dx} - g \frac{d \sin \alpha}{dx} \right) \cdot v.$$

Assuming that

$$\frac{d\beta}{dx}\, v = \Psi_1 \quad . \quad . \quad . \quad . \quad (2)$$

and

$$g\, \frac{d \sin \alpha}{dx}\, v = \Psi_2 \quad . \quad . \quad (3)$$

we get

$$\Psi = \Psi_1 - \Psi_2.$$

The acceleration β due to the centrifugal force must be calculated first of all. If v be the speed on the curve and ρ the radius of curvature, the acceleration of the centrifugal force will be

$$\beta = \frac{v^2}{\rho}.$$

As the radius of curvature can be taken as approximately equal to the reciprocal of the second differential quotient, we get

$$\beta = v^2\, y''.$$

When investigating the movement of the vehicle on curves only the longitudinal axis of the vehicle need be considered. We must, therefore, calculate the second differential quotient of the lines which, starting from the different points of the longitudinal centre line of the vehicle, will follow the curve during the passage of the vehicle over it.

The acceleration of the centrifugal force varies according as the vehicle is partly on the straight and partly on the transition curve, or is wholly on the transition, or again is partly on the transition and partly on the circular curve, or finally is wholly on the circular curve.

Let us first of all consider curves with a straight length between them, and in particular the case with the vehicle partly on the straight and partly on the transition (fig. 3). The point A moves on the transition which is taken as being a cubic parabola. At this point we have therefore :

$$y_A = \frac{x_A^3}{6\,C},\; y_A' = \frac{x_A^2}{2\,C},\; y_A'' = \frac{x_A}{C};$$

$$\beta_A = v^2 y_A'' = \frac{v^2}{C} \cdot x_A.$$

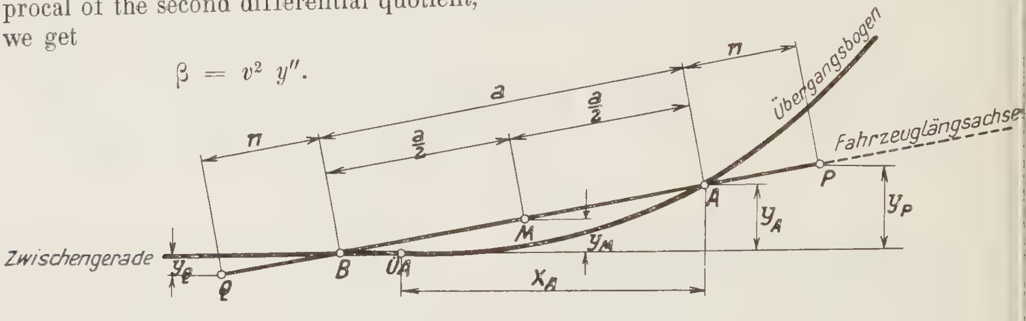


Fig. 3.

Note. — Fahrzeuglängsachse = longitudinal axis of the vehicle.

The point B moves on the straight length and the acceleration of this point is therefore nil.

$$\beta_B = 0.$$

For a point M in the middle, between the points A and B, we get

$$y_M = \frac{y_A}{2};$$

whence

$$\beta_M = \frac{v^2}{2\,C} \cdot x_A.$$

For a point P of the overhang of the vehicle beyond the leading axle, we get

$$y_P = \frac{a+n}{a} \cdot y_A ;$$

Whence the acceleration at the point P is

$$\beta_P = \frac{a+n}{a} \cdot \beta_A = \frac{a+n}{a} \cdot \frac{v^2}{C} \cdot x_A .$$

In the case of a point Q of the overhang behind the rear axle we get

$$y_Q = -\frac{n}{a} \cdot y_A$$

whence the acceleration at the point Q is :

$$\beta_Q = -\frac{n}{a} \beta_A = -\frac{n}{a} \cdot \frac{v^2}{C} \cdot x_A .$$

The acceleration in unit time is, from equation 2 :

$$\Psi_1 = \frac{d\beta}{dx} \cdot v .$$

From the values of β developed above we find :

$$\Psi_{1A} = \frac{v^3}{C},$$
$$\Psi_{1B} = 0,$$
$$\Psi_{1M} = \frac{v^3}{2C},$$
$$\Psi_{1P} = \frac{a+n}{a} \cdot \frac{v^3}{C},$$
$$\Psi_{1Q} = -\frac{n}{a} \cdot \frac{v^3}{C}.$$

In the case of a 4-wheeled vehicle with a wheelbase $a = 6$ metres, a curve of radius $R = 250$ metres, a transition curve of a fixed value $c = 7\,200$, a speed $V = 60$ kilometres an hour and an overhang $n = 2$ metres, the values are, for instance :

$$\beta_A = 0.0386\ x_A,$$
$$\beta_B = 0,$$
$$\beta_M = 0.0193\ x_A,$$
$$\beta_P = 0.0514\ x_A,$$
$$\beta_Q = -\ 0.0129\ x_A,$$
$$\Psi_{1A} = 0.643,$$
$$\Psi_{1B} = 0,$$
$$\Psi_{1M} = 0.321,$$
$$\Psi_{1P} = 0.857,$$
$$\Psi_{1Q} = -\ 0.214.$$

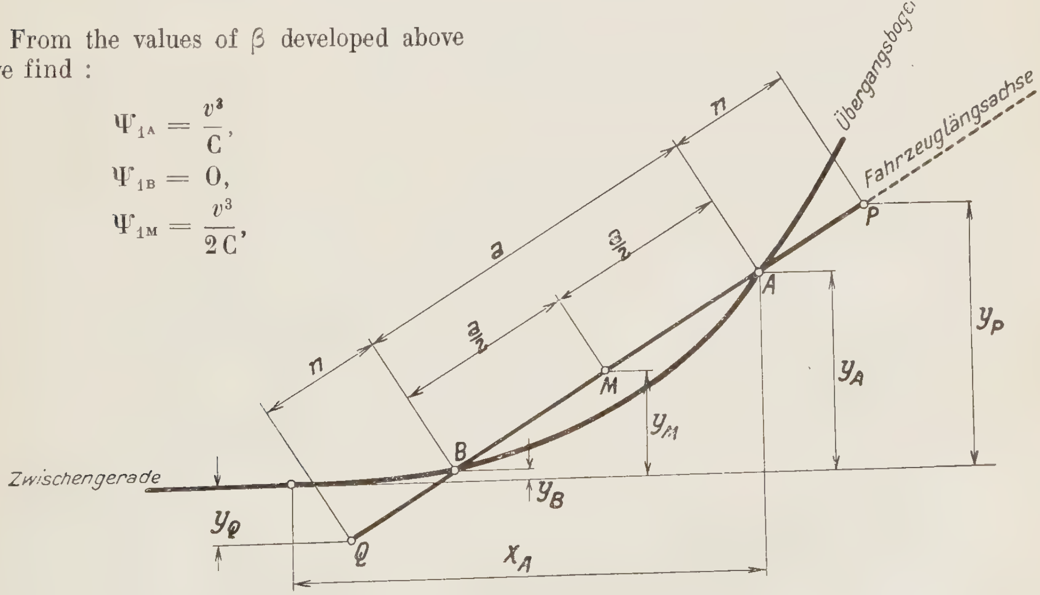


Fig. 4.

If the vehicle has its two axles within the transition (fig. 4) we get :

$$y_A = \frac{x_A{}^3}{6\,C}, \qquad \beta_A = \frac{v^2}{C} \cdot x_A, \qquad \Psi_{1A} = \frac{v^3}{C},$$

$$y_B = \frac{(x_A - a)^3}{6\,C}, \qquad \beta_B = \frac{v^2}{C}\,(x_A - a), \qquad \Psi_{1B} = \frac{v^3}{C},$$

$$y_M = \frac{y_A + y_B}{2}, \qquad \beta_M = \frac{v^2}{C}\left(x_A - \frac{a}{2}\right), \qquad \Psi_{1M} = \frac{v^3}{C},$$

$$y_P = \frac{a+n}{a}\,y_A - \frac{n}{a}\,y_B, \qquad \beta_P = \frac{v^2}{C}\,(x_A + n), \qquad \Psi_{1P} = \frac{v^3}{C},$$

$$y_Q = \frac{a+n}{a}\,y_B - \frac{n}{a}\,y_A, \qquad \beta_Q = \frac{v^2}{C}\,(x_A - a - n), \qquad \Psi_{1Q} = \frac{v^3}{C}.$$

On the other hand, when the axle *A* of the vehicle is on the curve and the other axle *B* on the transition (fig. 5), the acceleration at point *A* will be :

$$\beta_A = \frac{v^2}{R} \text{ and } \Psi_{1A} = 0.$$

For the point *B* we shall get :

$$\beta_B = \frac{v^2}{C}\,(x_A - a) \text{ and } \Psi_{1B} = \frac{v^3}{C}.$$

We also get :

$$y_M = \frac{y_A + y_B}{2}, \qquad \beta_M = \frac{v^2}{2\,C}\,(x_A - a) + \frac{v^2}{2\,R}, \qquad \Psi_{1M} = \frac{v^3}{2\,C},$$

$$y_P = \frac{a+n}{a}\,y_A - \frac{n}{a}\,y_B, \qquad \beta_P = -\frac{n}{a} \cdot \frac{v^2}{C}\,(x_A - a) + \frac{a+n}{a} \cdot \frac{v^2}{R}, \qquad \Psi_{1P} = -\frac{n}{a} \cdot \frac{v^3}{C},$$

$$y_Q = \frac{a+n}{a}\,y_B - \frac{n}{a}\,y_A, \qquad \beta_Q = \frac{a+n}{a} \cdot \frac{v^2}{C}\,(x_A - a) - \frac{n}{a} \cdot \frac{v^2}{R}, \qquad \Psi_{1Q} = \frac{a+n}{a} \cdot \frac{v^3}{C}.$$

When this vehicle is on the circular curve itself we find for all the points

$$\beta = \frac{v^2}{R} \text{ and } \Psi_1 = 0.$$

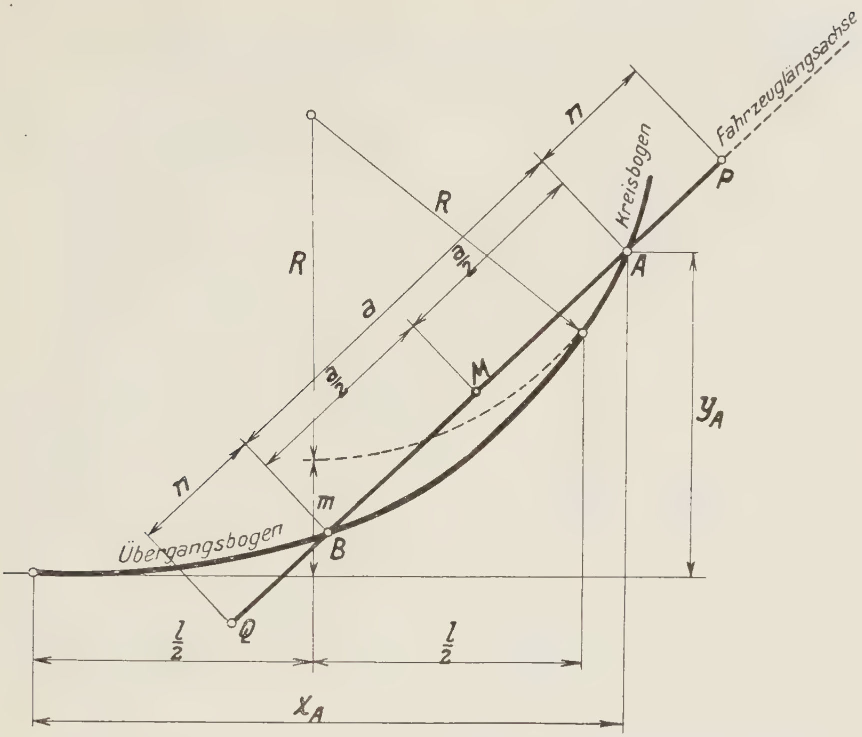
If there is no straight length between the transition curves and if the leading axle of the vehicle is on one transition and the other axle on the other transition (fig. 6), we get, with transitions of the same fixed value :

$$y_A = \frac{x_A^3}{6\,C}$$

and $$\beta_A = \frac{v^2}{C} \cdot x_A,$$

$$y_B = \frac{x_B^3}{6\,C} = \frac{(x_A - a)^3}{6\,C}$$

and $$\beta_B = \frac{v^2}{C} \cdot (x_A - a).$$


Fahrzeuglängsachse
n
Kreisbogen
P
R
R
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M
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y_A
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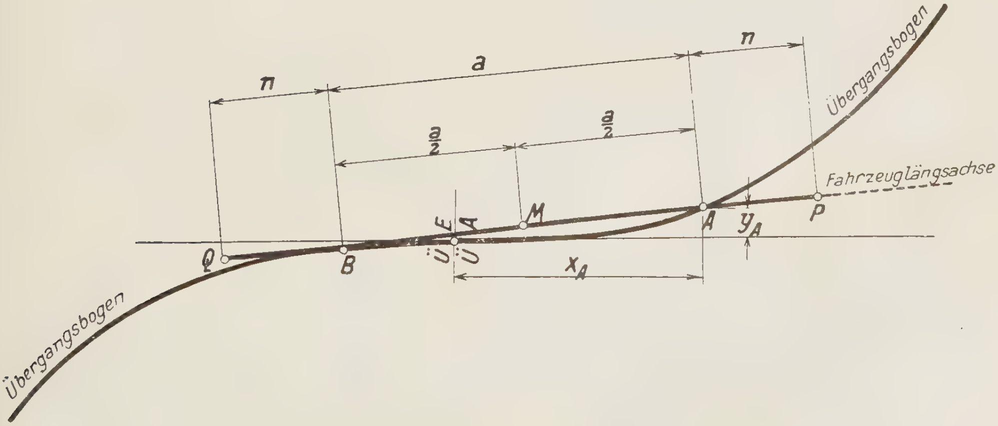
Übergangsbogen
B
Q
l/2
l/2
x_A

Fig. 5.


n
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Fahrzeuglängsachse
M
ÜE
ÜA
A
P
y_A
Q
B
x_A
Übergangsbogen

Fig. 6.

For point *M* we get :

$$y_{M} = \frac{y_{A} + y_{B}}{2} = \frac{x_{A}^{3} + x_{B}^{3}}{2\,C}$$

and

$$y''_{M} = \frac{x_{A} + x_{B}}{12\,C}$$

But as

$$x_{B} = x_{A} - a$$

we obtain

$$y_{M}'' = \frac{x_{A} - \frac{a}{2}}{C}$$

$$\beta_{M} = \frac{v^{2}}{C}\left(x_{A} - \frac{a}{2}\right).$$

In the same way

$$\beta_{P} = \frac{v^{2}}{C}\,(x_{A} + n),$$

$$\beta_{Q} = \frac{v^{2}}{C}\,(x_{A} - a - n).$$

It must be specially pointed out, however, that with reverse curves with no intermediate straight length, the value of C will be greater than when there is a straight length, the transition in the former case being longer than in the second.

The increase in acceleration in unit time for the different points will be

$$\Psi_{A} = \Psi_{B} = \Psi_{M} = \Psi_{P} = \Psi_{Q} = \frac{v^{3}}{C}.$$

When the vehicle is on the transition or partly on this transition and partly on the circular curve, or again entirely on the circular curve, the equations are the same as for curves and reverse curves with a straight length between them, except that the value of C is different.

The acceleration of the vehicle due to gravity is given by the expression $g \sin \alpha$. We can begin by supposing the underframe of the vehicle as being rigid and the floor a plane. When the vehicle runs onto the superelevation ramp (cant gradient), the axles take up an oblique position owing to the difference in level of the rails; this is only possible by the springs deflecting. The diagonally opposite springs either lift or drop the same amount $\frac{\Delta}{4}$. Δ here represents the amount one point (the point A' in figure 7) rises above the plane through the other three points. If, when there are straight lengths between the superelevation ramps of circular curves in opposite directions we represent by h_{A} the superelevation in the cross section A A' and by h_{B} in the cross section BB' and by K the height of the springs, the two rails being to the correct level and the vehicle stationary, the slope of the floor on the transverse cross section AA' is given by

$$\tan \alpha_{A} = \frac{h_{A} - \frac{\Delta}{2}}{s}.$$

But as $\Delta = h_{A} - h_{B}$, this formula becomes

$$\tan \alpha_{A} = \frac{h_{A} + h_{B}}{2\,s}.$$

In the cross section BB' we have

$$\tan \alpha_{B} = \frac{h_{B} + \frac{\Delta}{2}}{s} = \frac{h_{A} + h_{B}}{2\,s}.$$

This value is the same as that found for the slope of the floor in the cross section AA' or in other words the slope of the platform relatively to the projection of the track on the horizontal plane is the same at all cross sections.

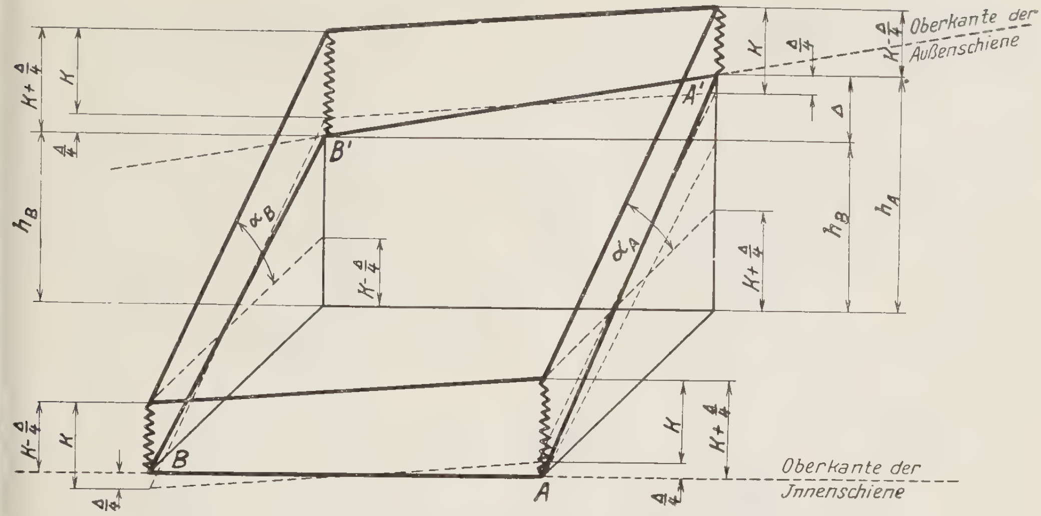

Fig. 7.

Note. — Oberkante der Aussenschiene (Innenschiene) = level of outer (inner) rail top.

In the range of values

$$x_A = 0 \text{ and } x_A = a$$

we have

$$h_A = \frac{h_0}{l} \cdot x_A,$$

h_0 being the superelevation right on the curve, l the length of the transition and x_A the abscissa of the cross section AA' (fig. 8). So long as point b is on the straight length, we get :

$$h_B = 0.$$

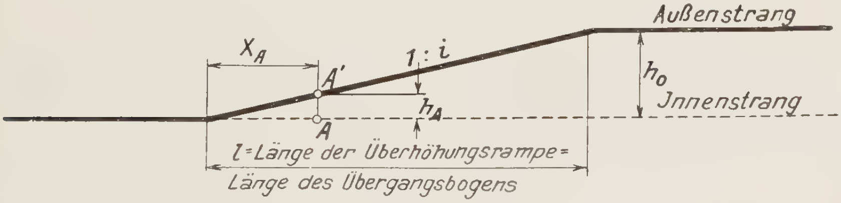

Fig. 8.

Note. — Länge... rampe = length of superelevation ramp. — Länge... bogens = length of transition curve. Aussenstrang = outer line of rails. — Innenstrang = inner line of rails.

Consequently

$$\tan \alpha = \frac{h_A}{2\,s} = \frac{h_0}{2\,ls}\,x_A = \frac{x_A}{2\,is},$$

When 1 : i is the incline rate of the superelevation ramp. The angle α being very small tan α can be taken as equal to sin α. In this case the acceleration due to gravity will be :

$$g \,.\, \sin \alpha = \frac{gh_0}{2\,ls} \cdot x_A = \frac{g}{2\,is} \cdot x_A.$$

The increase in the acceleration $g \sin \alpha$ in unit time is, from equation 3 :

$$\Psi_2 = g \cdot \frac{d \sin \alpha}{d x} \cdot v = \frac{g}{2\, is} \cdot v .$$

Ψ_2 is therefore constant.

In the range of values $x_A = l$ to $x_A = l + a$ (a = carriage wheelbase), we get

$$h_A = \frac{x_A}{l}$$

and

$$h_B = h_A - \frac{a}{i}.$$

Consequently

$$\tan \alpha = \frac{2\, x_A - a}{2\, is},$$

$$g \sin \alpha = \frac{g}{2\, is} (2\, x_A - a)$$

and

$$\Psi_2 = \frac{g}{is} \cdot v .$$

In the range of values $x_A = l$ to $x_A = l + a$, we get

$$h_A = h_o$$

and

$$h_B = \frac{h_o}{l} (x_A - a),$$

$$\tan \alpha = \frac{l + x_A - a}{2\, is},$$

$$g \sin \alpha = \frac{g}{2\, is} (l + x_A - a),$$

$$\Psi_2 = \frac{g}{2\, is} \cdot v .$$

On the curve itself

$$\tan \alpha = \frac{h_o}{s}$$

$$g \sin \alpha = \frac{g h_o}{s}$$

$$\Psi_2 = 0 .$$

The superelevation ramps of the adjacent curves can also be superimposed so that the level of one of the rails is lowered from leaving one curve until entering the other, from full to zero superelevation, whilst the level of the other is raised over this section progressively from zero to the full superelevation of the second curve (fig. 9).

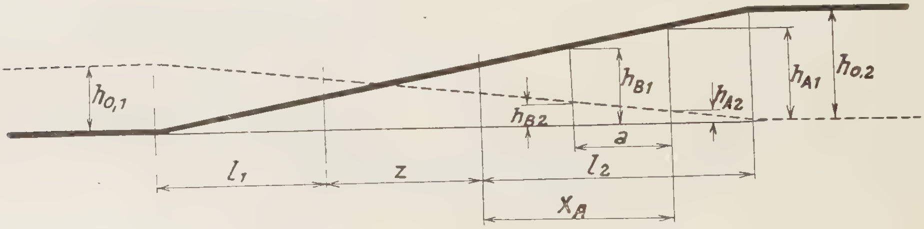

Fig. 9.

Admitting again, to start with, the existence of a straight section of length x between the transitions, we shall have according to figure 9 :

$$h_{A1} = \frac{h_{02}}{l_1 + l_2 + z} (l_1 + z + x_A),$$

$$h_{A2} = \frac{h_{01}}{l_1 + l_2 + z} (l_2 - x_A),$$

$$h_{B1} = \frac{h_{02}}{l_1 + l_2 + z} (l_1 + z + x_A - a),$$

$$h_{B2} = \frac{h_{01}}{l_1 + l_2 + z} (l_2 - x_A + a).$$

The difference in level of the points C and C′ of the carriage floor (on the cross section AA′) is, from figure 10 :

$$h_{A1} + K - \frac{\Delta}{4} - h_{A2} - K - \frac{\Delta}{4} = h_{A1} - h_{A2} - \frac{\Delta}{2}.$$

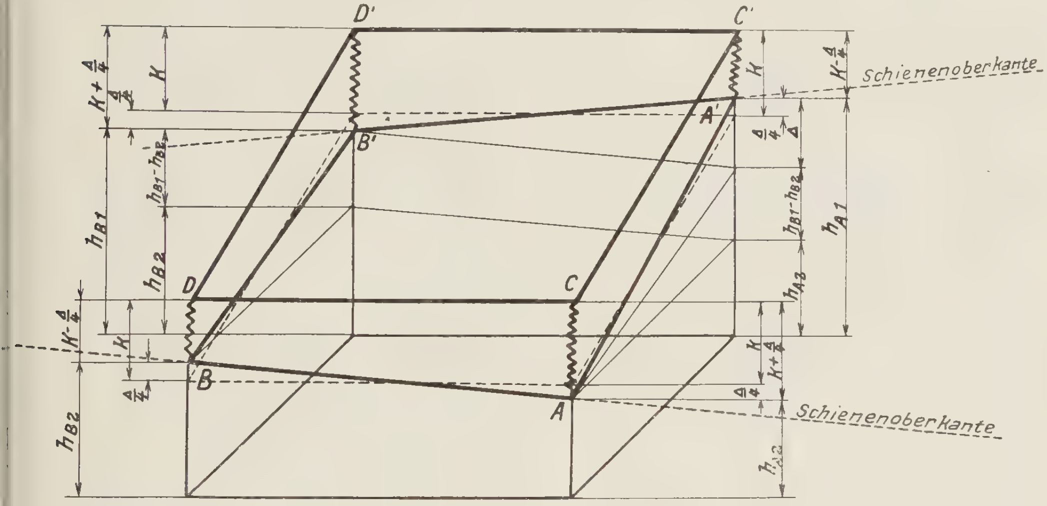

Fig. 10.

Note. — Schienenoberkante = level of rail top.

The difference in level of the points D and D′ (in the cross section BB′) is

$$h_{B1} + K + \frac{\Delta}{4} - h_{B2} - K + \frac{\Delta}{4} = h_{B1} - h_{B2} + \frac{\Delta}{2}.$$

Furthermore, from figure 10 :

$$\Delta = h_{A1} - h_{A2} - h_{B1} + h_{B2}.$$

Given this value the difference in level on the section AA′ and also on section BB′ is :

$$\frac{(h_{A1} - h_{A2}) + (h_{B1} - h_{B2})}{2}$$

The slope of the floor of the vehicle to the horizontal plane is therefore the same at all sections and equals :

$$\tan \alpha = \frac{(h_{A1} - h_{A2}) + (h_{B1} - h_{B2})}{2\,s}$$

If the reverse curves have the same radius and consequently transitions of the same length l and the same superelevation h_0, we shall have

$$\tan \alpha = \frac{h_0}{(2\,l + z)\,s}\,(z + 2\,x_A - a).$$

Consequently as an approximation

$$g \sin \alpha = \frac{g h_0}{(2\,l + z)\,s}\,(z + 2\,x_A - a)$$

and

$$\Psi_2 = \frac{2\,g h_0}{(2\,l + z)\,s} \cdot v.$$

However, if the vehicle has one axle on the transition and the other on the circular curve we have :

$$h_{A1} = h_{02} \quad \text{and} \quad h_{A2} = 0.$$

Consequently

$$\tan \alpha = \frac{h_{A1} + h_{B1} - h_{B2}}{2\,s}.$$

With

$$h_{01} = h_{02} = h_0$$

and

$$l_1 = l_2 = l$$

we shall get

$$g \sin \alpha = \frac{g h_0 (l + z + x_A - a)}{(2\,l + z)\,s}$$

and

$$\Psi_2 = \frac{g h_0}{(2\,l + z)\,s} \cdot v.$$

When there is no intermediate straight, the same formulae remain applicable, but in this case the transitions used should be longer, whilst the intermediate straight length is zero.

Figures 12 to 21 are given as examples of the values of the accelerations, and of the accelerations in unit time. The figures are based on a 4-wheeled vehicle with a wheelbase $a = 6$ metres with an overhang of $n = 2$ metres from the axle. The reverse curves have a radius of $R = 250$ metres, the speed $V = 60$ kilometres, $h^{-1} = 16\ 2/3$ metres per second. The length of the intermediate straight length between the transitions $Z = 10$ metres. The length l of the transitions is taken as equal to that of the superelevation ramps which have a slope of 1 in 300. From these data, in the case of the intermediate straight length, a length $l = 28.80$ m. and a fixed value of $C = 7\,200$ is found.

If the intermediate straight length is to be suppressed whilst leaving the reverse curves unchanged, the tangent should then be struck through the origin of the transition curve as shown in figure 11. In accordance with the indications of this figure, we get the following conditions :

$$\frac{L}{2} \cos \beta + (R + M) \sin \beta = \frac{z + l}{2},$$

$$(R + M) \cos \beta - (R + m) = \frac{L}{2} \sin \beta.$$

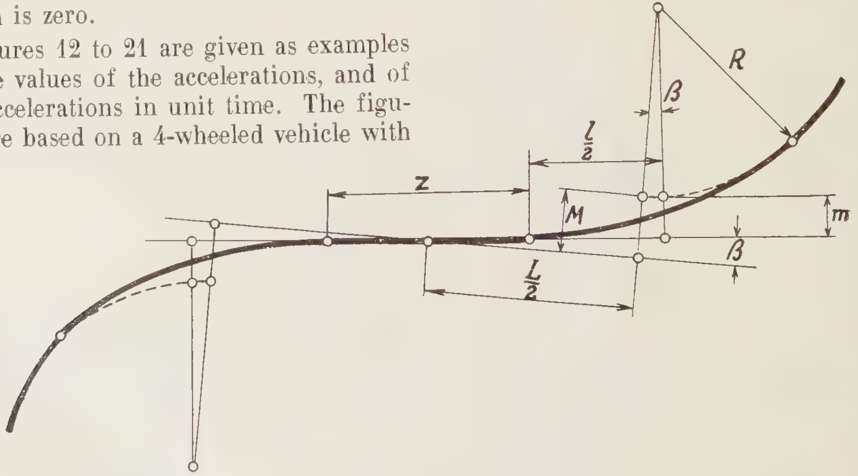

Fig. 11.

Squaring these equations and then adding them we get the equation

$$\left(\frac{L}{2}\right)^2 + (R + M)^2 = \left(\frac{z + l}{2}\right)^2 + (R + m)^2.$$

For parabolas of the third degree we have

$$M = \frac{L^2}{24\ R} \text{ and } m = \frac{l^2}{24\,R}.$$

Whence the final result :

$$L = \sqrt{24\ [R\sqrt{15\ R^2 + \left(\frac{z + l}{2}\right)^2 + \left(R + \frac{l^2}{24R}\right)^2} - 4\,R^2]}.$$

Using the values given above, $L = 36.56$ metres and the corresponding fixed value of $C = 9\,140$.

The superelevation in the circular curve is 96 millimetres and the slope of the superelevation ramp 1 in 300 with a 10-metre straight section between the transitions. If this straight section be suppressed the slope of the superelevation ramp becomes 1 in 381, which is much less than in the arrangement with an intermediate straight section in use up to now, and represents an appreciable improvement.

Figures 12 to 16 show the accelerations to which a body supported by the floor of the vehicle is subjected when the vehicle is moving :

a) Over the transition curves between reverse curves, with an intermediate straight section between the beginning of one transition curve and the end of the other, the transition curve and superelevation ramp being equal;

b) Over the transition curve between reverse curves if the end of one transition and the beginning of the other coincide without any intermediate straight section, and if the level of one of the rails is lowered from the end of one curve to the beginning of the other from the full superelevation to zero whilst the level of the other in this section increases from zero to the full superelevation of the second curve;

c) Over the transition curves of reverse curves with a straight intermediate length between the end of one transition and the beginning of the other and when the superelevation ramps gradually merge into one another as in case *(b)*.

The accelerations are given for :

1. a point above the leading axle (b_A);
2. a point above the rear axle (b_B);
3. a point at the centre between the axles (b_M);
4. a point at the forward end of the overhang (b_P);
5. a point at the trailing end of the overhang (b_Q).

The distances of the cross sections of the vehicle noted during their passage over the track starting from the zero point are given on the axis of the abscissae. When there is an intermediate straight length, the zero point is taken at its middle and, when there is no such straight, where the adjacent transitions meet.

The accelerations originating in the different sections of the vehicle are marked off as ordinates above the points these sections pass over; the positive accelerations of the left half of the layout of the reverse curves are shown upwards and those of the right half downwards.

The continuity of the acceleration shows itself as a straight line extending from above at the left downwards to the

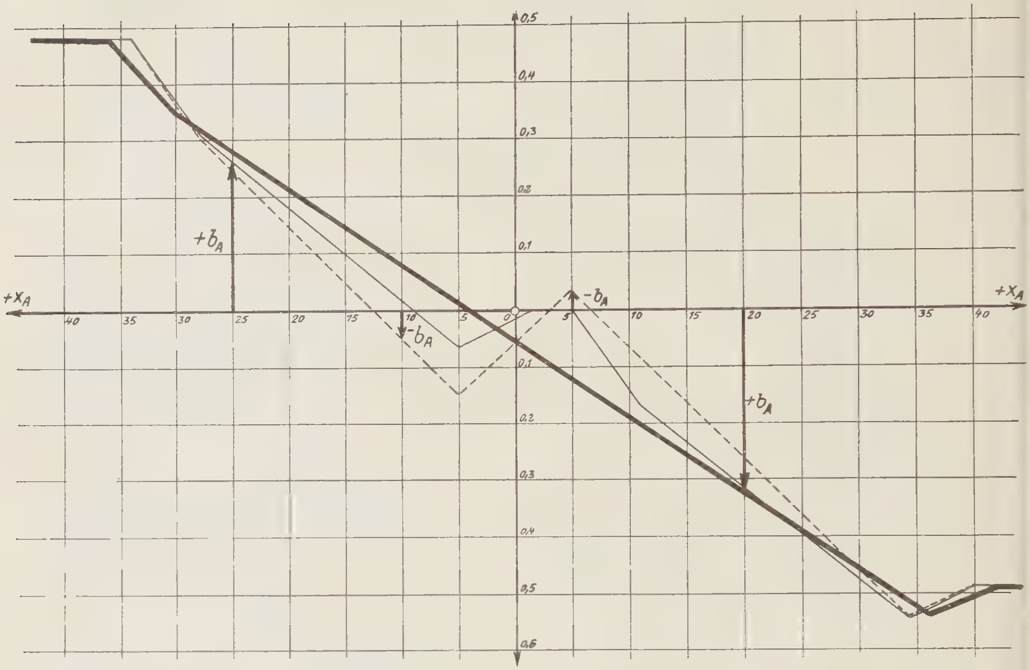

Fig. 12. Acceleration b_A.

Case *a*) ——— With straight intermediate length, superelevation ramp and transition curve of the same length.

Case *b*) ▬▬▬ Without straight intermediate length, continuous superelevation ramp from the end of one curve to the beginning of the other.

Case *c*) - - - - - With intermediate straight length, but with superelevation ramp as in case *b*).

right. The more or less great variations of the acceleration are shown by the magnitude of the angle between the straight lines representing the acceleration.

If the values of the accelerations are compared we find that the greatest accelerations of a point at the middle of the vehicle (fig. 14) reach about 0.483 m. per sec. per sec. and therefore do not attain 0.5 m. per sec. per sec. approximately the maximum permissible value. All the other points (point A and B over the axles and P and Q at the overhanging ends) give a peak exceeding 0.5 m. per sec. per sec.

The maximum value of the acceleration of the points over the axles (A and B), providing the superelevation, the dimensions of the vehicle, speeds, etc. given are correct, is the following :

When there is an intermediate straight length and superelevation ramps of the same length as the transitions. . . .	0.549 m. per sec. per sec.
When there is no intermediate straight length and when the superelevation	

ramps of the two lines of rails extend from the beginning of one curve to the end of the other	0.535 m. per sec. per sec.
When there is a straight intermediate length, but the superelevation ramps are the length given above	0.539 m. per sec. per sec.

For the points P and Q of the overhanging ends the maximum acceleration values are :

First case.	0.626 m. per sec. per sec.
Second case.	0.596 m. per sec. per sec.
Third case.	0.616 m. per sec. per sec.

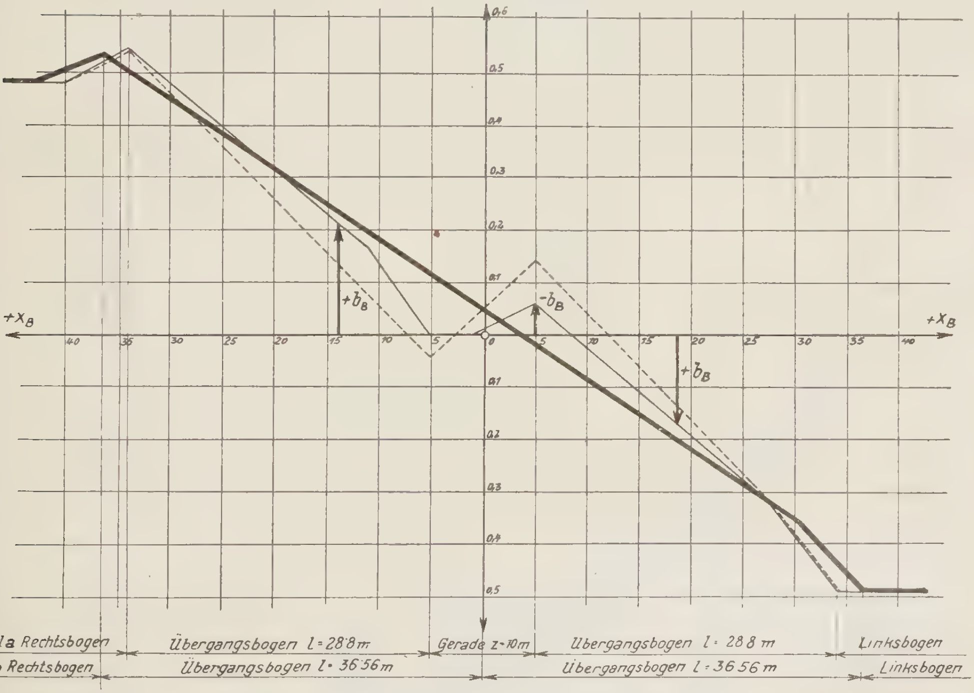

Fig. 13. — Acceleration b_B.

Case *a*) ——— }
Case *b*) ▬▬▬ } See fig. 12.
Case *c*) - - - - - }

Note. — Fall = case. — Rechtsbogen = right-hand curve. — Linksbogen = left- hand curve. — Gerade = straight section.

Consequently, the maximum acceleration values are in the first case 13.7 % higher above the axles than in the middle, in the second case only 10.8 % and in the third 11.6 %.

The highest values of the acceleration at the overhanging ends are 29.6 % greater than at the middle in the first case, only 23.4 % in the second, and 27.5 % in the third.

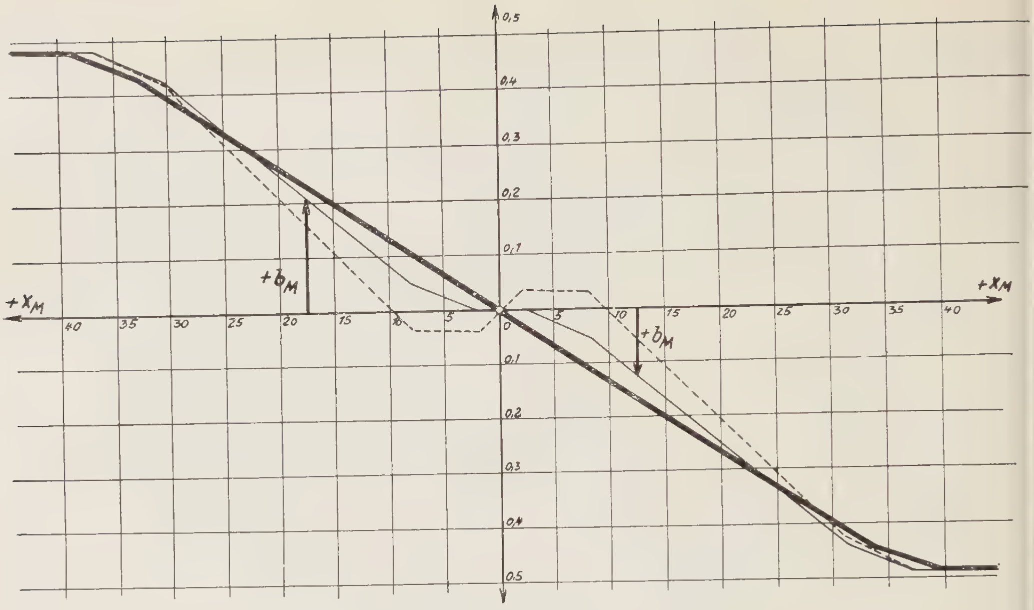

Fig. 14. — Acceleration b_M.

Case *a*) ——— }
Case *b*) ▬▬ } See fig. 12.
Case *c*) - - - - - }

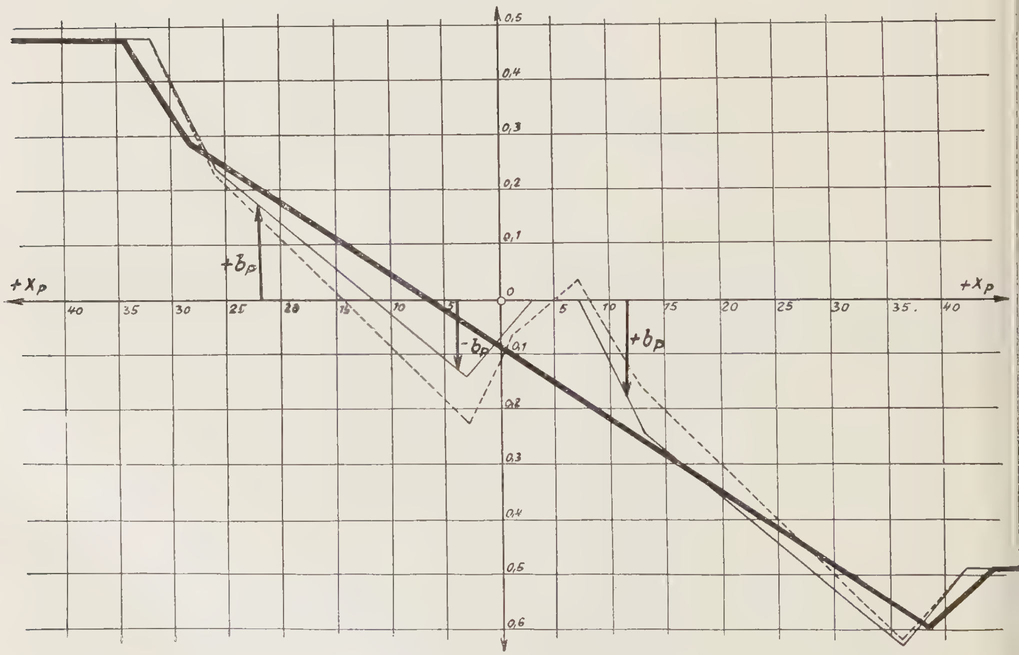

Fig. 15. — Acceleration b_P.

Case *a*) ——— }
Case *b*) ▬▬ } See fig. 12.
Case *c*) - - - - }

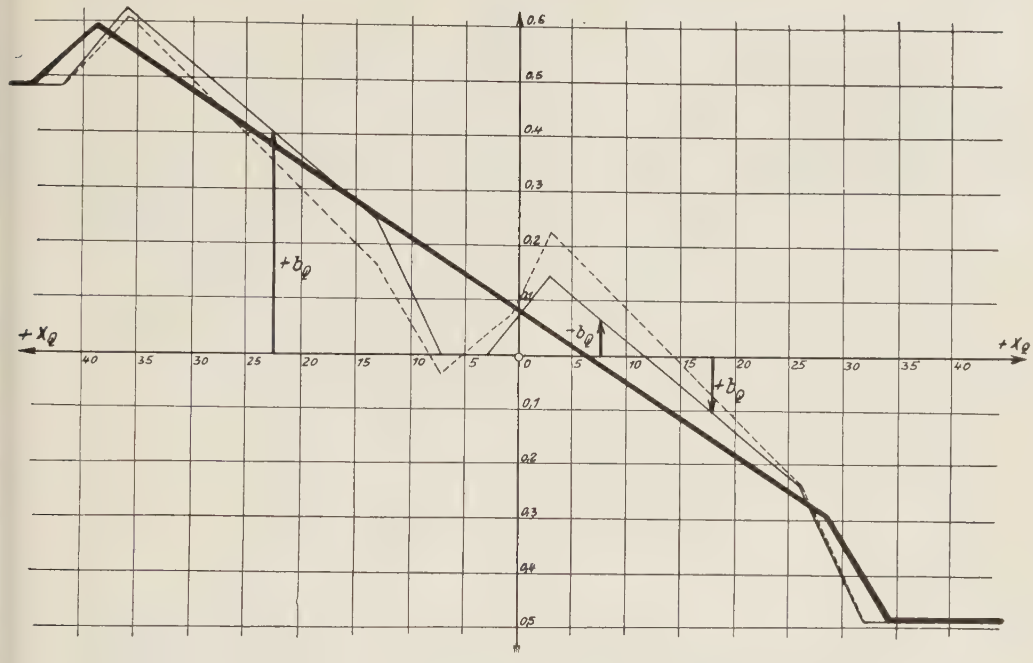

Fig. 16. — Acceleration b_Q.

Case a) ——— } See fig. 12.
Case b) ▬▬
Case c) - - - - -

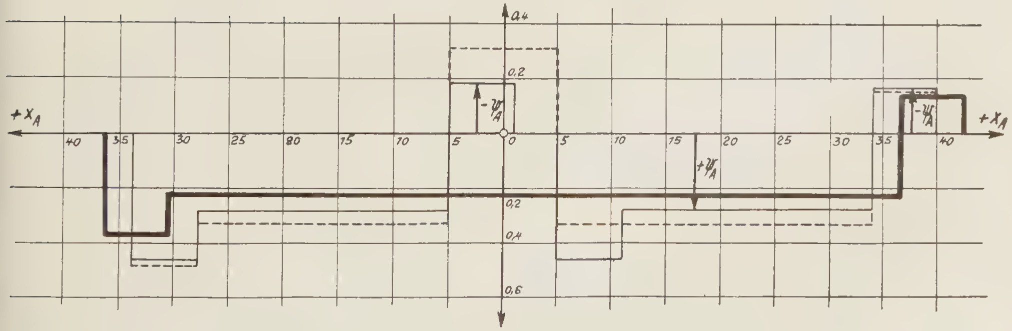

Fig. 17. — Acceleration ψ_A in unit time.

Case a) ——— } See fig. 12.
Case b) ▬▬
Case c) - - - - -

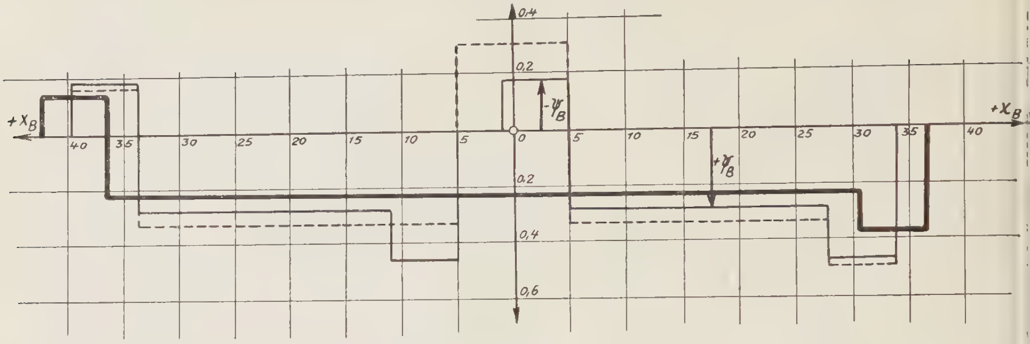

Fig. 18. — Acceleration ψ_B in unit time.

Case *a*) ———
Case *b*) ▬▬
Case *c*) - - - - -
As in fig. 12.

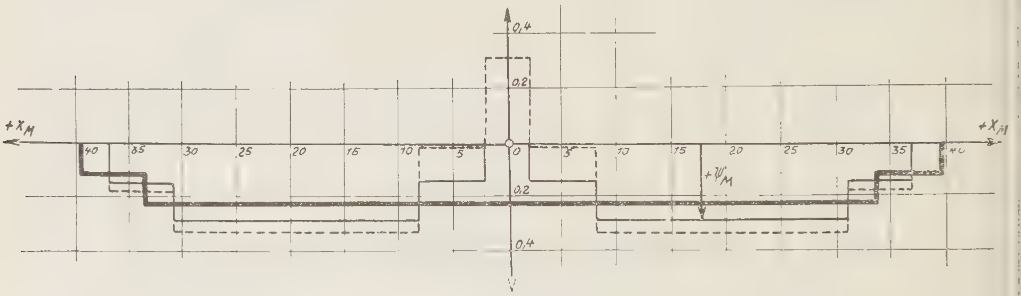

Fig. 19. — Acceleration ψ_M in unit time.

Case *a*) ———
Case *b*) ▬▬
Case *c*) - - - - -
As in fig. 12.

These maximums occur in all cases at the leading axle and the front overhang, in passing from the cubic parabola onto the circular curve properly speaking, and at the trailing axle and overhang when passing from the circular curve onto the cubic parabola.

These values are much higher than the corresponding values at the middle of the vehicle. The way the section of track between the end of one curve and the beginning of the other is laid cannot change the conditions very much, the cause being that the conditions do not differ very much at the junction of the transition and the circular curve, whether there is or is not an intermediate straight length. The greater length and therefore higher fixed value of the transition in the second case should improve the conditions somewhat.

The maximum values ought always to occur at the connection between the cubic parabola and the circular curve, seeing that, from the formulae developed above, the acceleration of the centrifugal force above the axles reaches at this point the value found right on the curve — where

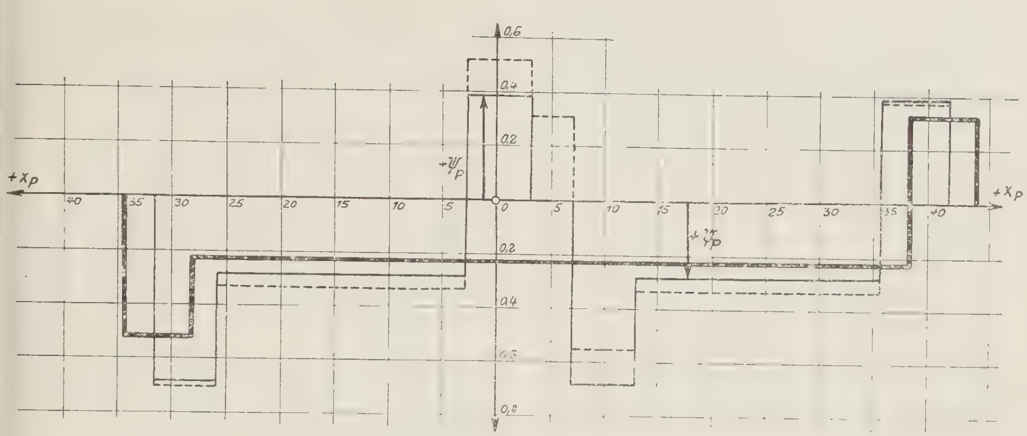

Fig. 20. — Acceleration ψ_P in unit time.

Case *a*) - -
Case *b*) ═══ } As in fig. 12.
Case *c*) - - - - -

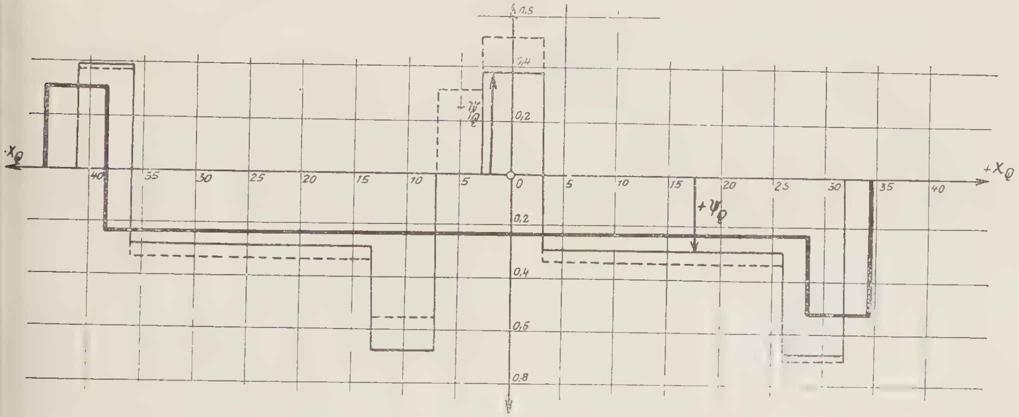

Fig. 21. — Acceleration ψ_Q in unit time.

Case *a*) ——
Case *b*) ═══ } As in fig. 12.
Case *c*) - - - - -

moreover the value is greatest — and also because the acceleration $g. \sin \alpha$ due to the superelevation and which has a decreasing effect, only reaches the highest value for points above the axle when the vehicle has its two pairs of wheels on the circular curve itself (fig. 22).

The radius of curvature of a line traced by any point of the overhang decreases continuously to the point of junction between the cubic parabola and the circular curve ($x_A = l$) and becomes even smaller than the radius of the circular curve, and it then increases for $v_A > l$ up to the value of this radius.

We get in fact for

$$l + a > x_A > l$$

for the point P

$$y'' = \frac{a+n}{aR} - \frac{n}{a} \cdot \frac{x_A - a}{C}.$$

If we take $C = lR$, the radius ρ of the line described by the point P is approximately :

$$\rho = \frac{1}{y''} = \frac{R}{1 + \frac{n}{a} \cdot \frac{l - x_A + a}{l}}.$$

As $x_A < l + a$, ρ must always be $< R$.

When $x_A = l + a$, $\rho = R$ as stated above.

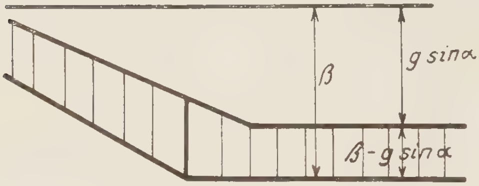

Fig. 22.

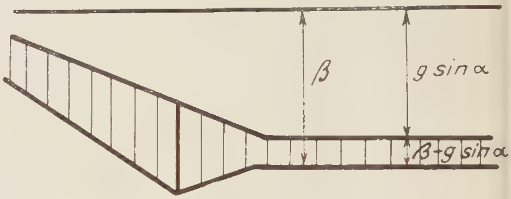

Fig. 23.

The acceleration β of the centrifugal force for points above the overhang can be traced as in figure 23. The conditions can be improved in laying the track by making the *superelevation as great as possible* and the *transition curve as long as possible.* This can be achieved by *eliminating the intermediate straight.* The important thing is to *keep the overhang as small as possible* and to make *the ratio of the overhang to the wheelbase* or distance between bogie centres as small as possible. The *bogie vehicle* is the best solution. Bogie vehicles have moreover the special advantage that the pivot is subjected to almost the same conditions as those at a point in the middle between two axles. In this case the sharp angle, characteristic of the acceleration curve in the section over the bogie centres when passing from the transition to the circular curve, disappears to become a chord. Conditions are also improved at the overhanging ends.

Doing away with the intermediate straight lengths has the further advantage, as shown by figures 12 to 16, that the continuity of the acceleration only varies at *four points of discontinuity* whereas there are *eight such points* with the usual arrangement *with an intermediate straight section,* and superelevation ramps of the same length as the transitions. When the straight section is retained and the ramps extending from the end of one curve to the beginning of the other are made continuous, there are six points of discontinuity for points over the axles and eight for all other points of the vehicle.

In deciding the opportunity of the above layout the increase in the acceleration in unit time (Ψ) is another decisive factor.

In figures 17 to 21 the rise in acceleration in unit time Ψ' is represented by the ordinate for the same points at which the accelerations are represented by

$$\Psi_A, \Psi_B, \Psi_M, \Psi_P, \Psi_Q$$

The acceleration in unit time is represented in the three possible layouts of the transition curve and intermediate straight sections of reverse curves. For the zero point of the axis of the abscissae, etc. the same data can be used as for the accelerations. The acceleration in unit time is shown downwards if increasing, and upwards if decreasing.

If the increase in the acceleration in unit time exceeds 0.5 m. (1.64 ft.) per sec. per sec., the effect on the passenger is unpleasant. This value is not reached at the centre of the vehicle nor over the axles. At the overhanging ends it is exceeded when passing from the curve onto the transition and from the transition on to the straight section and inversely, but only when there is an intermediate straight length. Consequently when the value of Ψ' is studied, the arrangement without intermediate straight length is found to be better than when there is such a straight section; nor is there any advantage in extending the superelevation ramp from the end of one to the beginning of the other curve whilst retaining the intermediate straight length.

Figures 17 to 21 show clearly, moreover, that when the intermediate straight section is eliminated, the increase — or the decrease — of the acceleration takes place quite regularly, except where the circular curve properly speaking and transition curve meet, an improvement already referred to above. With bogie vehicles the line Ψ' is like that for points at the middle of a 4-wheeled vehicle.

Summary. — The equations developed, the numerical results relating to a special case and the diagrams given, clearly demonstrate that the transverse accelerations of the floor of the vehicle are smaller, and therefore more bearable for the passenger, as the length of the transition is increased the overhang reduced and the vehicle wheelbase, or as the case may be, the distance between bogie centres or bogie wheelbase lengthened. Bogie coaches have the advantage in this respect over 4- or 6-wheeled vehicles.

In addition, by eliminating the short intermediate straight lengths, and by correcting the layout from the beginning of one curve to the end of the other, the further advantage is gained that the accelerations change more regularly than under present methods, this being quite apart from the reduction of the transverse acceleration of the vehicle floor.

[621. 132.8 (.44) & 621 4 (.44)]

French State railcar fitted with a producer-gas engine,

by Henry MARTIN,

Ingénieur des Arts et Manufactures.

(Le Génie Civil.)

The French State Railways have recently carried out trials with a new railcar fitted with an engine fed by a charcoal gas producer.

The experience acquired during a number of years with road vehicles decided the State Railways to test a plant of this kind on a railcar.

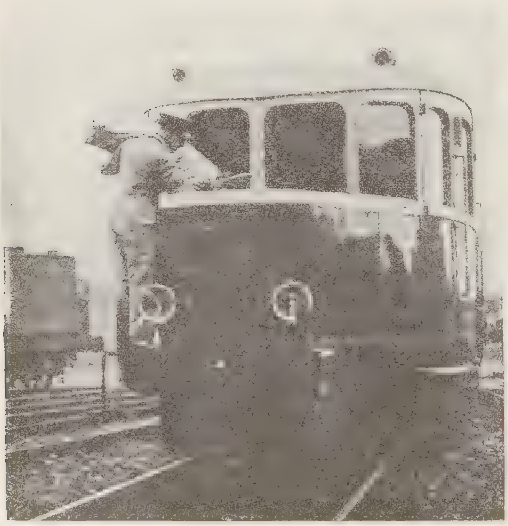

Fig. 1. — View showing the producer being filled

The test was carried out on one of the S.O.M.U.A. railcars. The vehicle had already run 45 000 km. (27 960 miles) and had a strong frame designed to carry a relatively powerful diesel engine; it was therefore very suitable for the experiment.

The unit consists of a 4-wheeled power vehicle and a 2-wheeled trailer (see figs. 2 and 3), the latter being carried at the back of the power unit on a pivot.

The new Panhard engine replaced the old diesel engine at the leading end of the car, and drives the gear box at the centre of the car which in turn drives two of the axles by means of two driving shafts and bevel gears.

The producer is carried at the back end of the trailer in a extension of the body. A cooler is carried under the floor of the trailer and two sets of dust filters in front of this vehicle.

This arrangement was used as the producer can be filled up from outside without any inconvenience to the passengers. This is very easy to do as the charcoal is delivered in 25-kgr. (55 lb.) paper bags (fig. 1).

Producer. — The Panhard producer has the same parts as those used on lorries (1). The only slight alteration was to the hopper which had to be made to suit the available space in the body (fig. 4).

The generator is a tank made of plate lined with refractory material and holds 200 kgr. (440 lb.) of charcoal.

No water injector is fitted, and this simplifies the arrangement. The charcoal is distributed to the fire by a deflector in the lower part of the hop-

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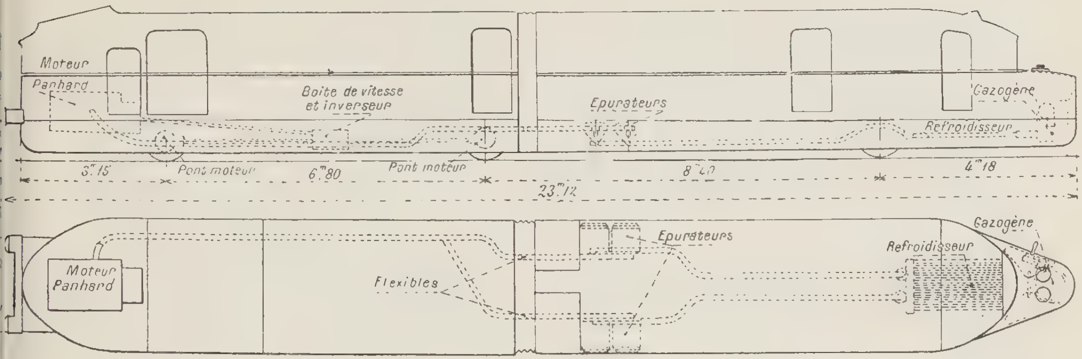
(1) The *Génie Civil* has dealt several times with producer-gas engined lorries in particular in the numbers of the 24th April 1920, p. 396, and 1st January 1927, p. 1.



Figs. 2 & 3. — Elevation and diagram of the producer railcar in service on the State Railways

Explanation of French terms:

Moteur Panhard = Panhard engine. — Boîte de vitesse et inverseur = gearbox and reverse gear. — Gazogène = gas producer. — Refroidisseur = cooler. — Pont moteur = driving axle. — Flexibles = flexible pipes. — Epurateurs = filters.

per, which causes the charcoal to form a cone round about which the combustion air is distributed. This air enters through the intake of the lighting-up fan, passes between the two walls of the generator, and is heated slightly, whilst at the same time keeping down the temperature of the outside casing.

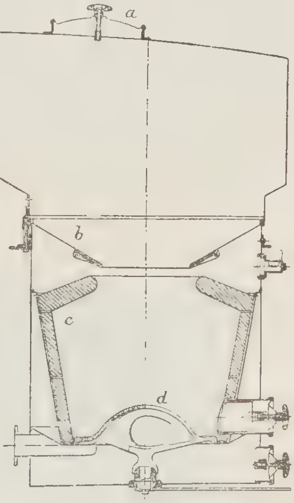
The gas formed in the producer then passes to the cooler.

Cooler and filters. — The cooler under the floor of the trailer consists of 14 steel cubes, B, 40 × 50 mm. (1 9/16″ × 1 31/32″) arranged in parallel between two headers A and C (figs. 5 and 6).

The outlet header of the cooler has two pipes E and F, each of which can be connected to two filters arranged in series.

In these filters, which work dry (figs. 8 to 10), the gases pass through cotton sheeting carried on metal frames. At the outlet of each group of filters, a safety device is fitted, consisting of very fine wire gauze which would choke up at once if the gas still contained any dust, and the engine would cease being fed before being damaged.

The two groups of filters are independent of one another, so as to prevent the railcar having to be stopped if one of the filters were damaged.



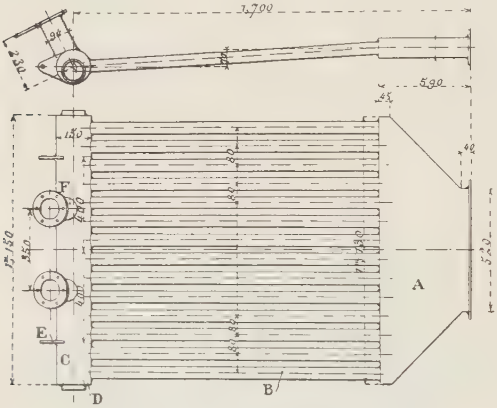
a) Filling door.
b) Hopper.
c) Generator.
d) Grate.

Fig. 4. — Vertical section through the producer.

Mixer. — Before being fed to the engine, the gases pass through a mixer carried on it. This mixer consists of a pipe with two branches, one for air and the other for the gas.

The engine can also run on petrol so that the producer need not be lighted up when shunting in the depots. The air can be controlled by a valve operated by a handle conveniently placed in front of the driver and controlling a throttle chamber.

Engine. — The sleeve-valve Panhard engine is of the 12-cylinder V type 120 mm. (4 3/4″) bore, and 160 mm. (6 5/16″) stroke, which corresponds to a swept volume of 21.7 l. (0.76 cu. ft.). The horse-power is 200 at 1 650 r.p.m.



Figs 5 & 6. — Elevation and plan of a cooler.

The cylinders and heads are made of aluminium. The crankshaft has 7 bearings. The large end of the connecting rod of one cylinder also acts as that of the opposite cylinder, the connecting rods being articulated together. The pistons work in white-metalled high-tensile steel sleeves, and are therefore less likely to wear oval.

Another advantage of the sleeve-valve engine in the case of producer gas is the particularly good form of the combustion chamber with its centrally placed sparking plug. The gas can get into the cylinders through the large openings in the sleeves without wire drawing, and the burnt gases are exhausted completely and very rapidly.

Two starters are provided, one on each side of the engine and drive the flywheel through a Bendix driver which engages on a toothed ring solid with the flywheel.

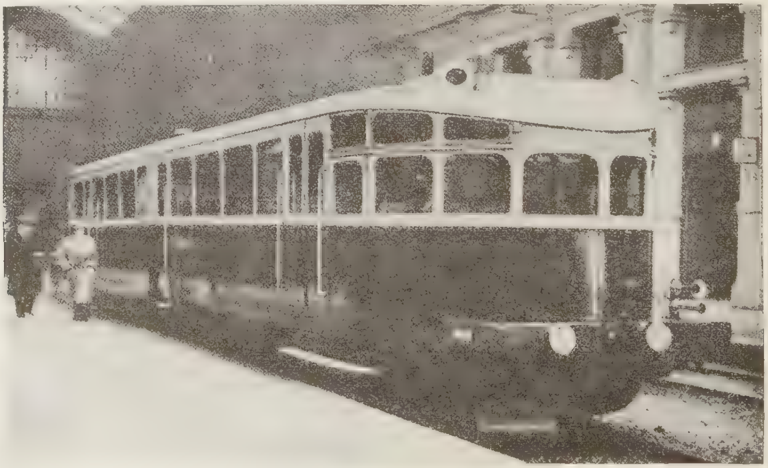
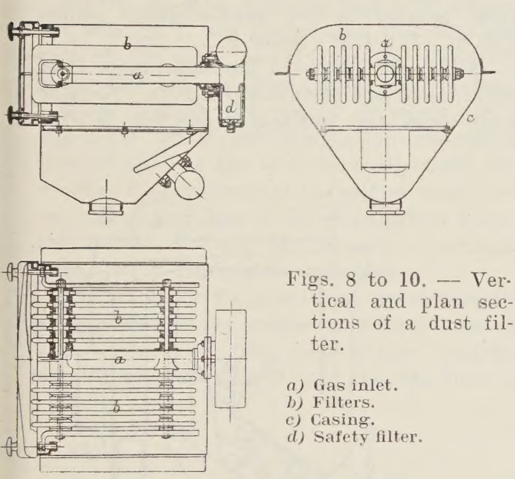


Fig. 7. — View of producer-gas engined railcar.

The starting current is supplied by a S.A.F.T. battery of cadmium-nickel cells.

Frame. — The gearbox on the S.O.M.U.A. railcar has four speeds in each direction owing to the provision of a reverse gear. It is controlled pneumatically, like the clutch and reverse.



Figs. 8 to 10. — Vertical and plan sections of a dust filter.

a) Gas inlet.
b) Filters.
c) Casing.
d) Safety filter.

The wheels, fitted with shock absorbers, are 872 mm. (2′ 10 5/16″) in diameter, and the journals run in roller bearings. A Westinghouse brake acting on drums, and a hand brake are fitted.

The railcar weighs 29.3 t. (28.8 Engl. tons) empty, and 37.5 t. (36.9 Engl. tons) loaded. There are 75 seats and room for 25 passengers standing. The floor area of the luggage compartment is 6.2 m^2 (66.7 sq. ft.), corresponding to about 1 ton of luggage.

The car is heated by an independent oil-fired boiler.

Results of trials. — The engine developed 215 H.P. at 1 730 r.p.m. The consumption of charcoal was 400 gr. (0.88 lb.) per H.P. hour. Under these conditions, the speed of the railcar was 105 km. (65.2 miles) an hour on the level. The railcar was first used to carry newspapers over the Paris-Le Mans line (211 km. = 131.1 miles). The railcar carried 5 tons of load, and made six booked stops, the overall speed thus being 85 km. (52.8 miles) an hour. At the present time the double unit works a local passenger service in the Gisors area, and runs 300 km. (186 miles) per day. The consumption of charcoal is about 80 kgr. per 100 km. (282 lb. per 100 miles).

In view of the very encouraging results obtained with this experimental vehicle, the State Railways have ordered producer gas engines for new vehicles, now under construction.

MISCELLANEOUS INFORMATION.

[656. 212. 6 (.44)]

Wagon tipper at Saint-Georges-de-Commiers (Isère) Station.

(Le Génie Civil.)

Saint-Georges-de-Commiers is a station situated on the Paris-Lyons-Mediterranean standard-gauge line from Grenoble to Marseilles via Veynes, Pertuis and Aix, a little before it crosses the Drac, a tributary of the Isère. It is also the junction for the metre-gauge light railway up the Drac Valley to La Mure, the electrification of which in 1905 was described in the *Génie Civil* of the 2nd June 1906. This line was recently extended to Corps, when the electric transmission lines were rearranged as described in the *Génie Civil* of the 22nd February 1936, p. 195.

This line passes through La Motte-d'Aveillans, where there are the La Mure anthracite deposits, and from which station a small branch runs to Notre-Dame-de-Vaux and serves the Comberamis mines. The largest part of the traffic over the line is the anthracite from these mines to St. Georges-de-Commiers, where it is transhipped into standard-gauge wagons.

In order to speed up this transhipment, the Paris-Lyons-Mediterranean Railway Company has just obtained from Messrs. Joseph Paris, in conjunction with the Applevage Company, a high-capacity wagon tipper with certain interesting features.

The metre-gauge wagons *w* are of 10-ton capacity, and that of the standard-gauge wagon W is 20 tons, so that two *w* wagons have to be tipped to fill a W wagon. The metre-gauge track was 2.35 m. (7′ 8 1/2″) above the standard-gauge track, and could not be raised any further. The difference in level was sufficient for the first *w* wagon to be tipped into W by simple rotation about a centre line parallel to both tracks, but, owing to the height of the coal after this operation, the second *w* wagon had to be lifted before rotating it.

The main feature of the tipper is the double gantry spanning the metre-gauge track lying parallel to the standard-gauge siding, 2.35 m. (7′ 8 1/2″) below it.

The gantry carries a moveable table P of welded and very rigid constructions. The side away from the standard-gauge line is free and can be raised by the winches T_1, whereas the other side near the standard gauge track is guided by the rollers G sliding in grooves in the gantry columns. The winches T_2 therefore can only move this side vertically in the plane of the columns.

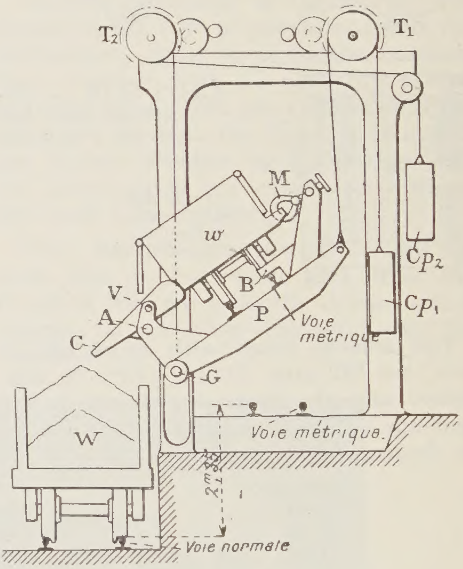


Diagram of the wagon tipper.

Note : Voie métrique = metre gauge. — Voie normale = standard gauge.

The *w* wagons to be tipped are brought one by one onto the table P and firmly held in place by the stops B and the holding jaws M, whilst the standard-gauge wagons to be loaded are shunted into place alongside the tipper. As soon as the *w* wagon is ready to be tipped the chute C, which normally stands upright to let the *w* wagons pass, is turned on its axis A and locked in the discharge position by the lock V.

To tip the first *w* wagon into a W wagon, the winches T_1 are started and this lifts the side of the table away from the standard-gauge line and so gives the desired rotation. When tipping the second *w* wagon, both winches T_1 and T_2 are brought into use, which first of all lifts the table vertically until the winches T_2 have reached the end of their travel, and then rotate it as before. This keeps the distance the coal has to drop to a minimum, which reduces the breakage.

The whole of the operations are automatically controlled by means of 3 push buttons and contactors. The first button controls the lift of the winch T_1 and tips the first *w* wagon; the second controls the simultaneous lift of the winches T_1 and T_2 and tips the second *w* wagon; when the third is pressed down, the table P is lowered and restored to the horizontal.

As soon as a button is pressed down, the corresponding movement begins and continues so long as the button is depressed. In practice, however, the tipper is allowed to stop by itself as it is fitted with an automatic device which stops it in the raised or lowered position or when the slope of the table P reaches 40°.

The stops are very accurate and no slack is left in the lifting cables when the table is down, so as to prevent any shock when starting the next lifting movement.

The dead weight of the table P and of the wagon *w* being tipped are balanced by the weights CP_1 and CP_2 so as to tip quickly with a low power consumption.

Three men are able to tip 15 ten-ton wagons an hour.